Field Strength Meter

Multimetter FSM 650

User Manual

Ref.5923

Televés

www.televes.com

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SAFETY MEASURES

Before using the equipment, read the user manual and read the section on SAFETY MEASURES.

The symbol on the equipment indicates: “SEE USER MANUAL”.

This manual may also contain the Caution or Warning symbols.

CAUTION AND WARNING messages may appear in this manual in order to avoid the risk of accidents or to avoid causing damage to the equipment or to other property.

Televés S.A. hereby advises the consumer to consult with local officials and other legal authorities regarding the proper use and application of this product in compliance with all applicable state and federal laws.

Televés S.A. shall not be responsible for any misure or unlawfull application of this product by any individual or entity under any circumstances.

"**Televés, S.A.** hereby states, under its own responsibility, that this product is in compliance with the orders of the Directive 99/05/CE of the European Parliament and Council dated 9th March 1999, adopted by Spanish legislation by Royal Decree 1890/2000 of 20th November”.

The assessment of this device's conformity is guaranteed by the "assurance of total quality (ISO 9001)".

CE 0341

1.- INSTALLATION

1.1.- SAFETY MEASURES

- **The non-specified use of the equipment** does not ensure its safety.
- The external DC adapter is **class I** equipment, so for safety reasons it should be connected to **a supply line with the corresponding ground terminal**.
- This equipment can be used in installations with **Overvoltage Category II** and in environments with **Pollution Degree 2**.
- When using any of the following accessories, it is necessary to use only those types **specified** for reasons of safety:

  Rechargeable battery

  External DC adapter
- Always take the **specified margins** into account both for the power supply as well as for the measurements.
- Remember that any voltages above **60 V DC** or **30 V AC** rms are potentially dangerous.
- Always check the **specified maximum environmental conditions** for this equipment.
- The user is only **authorised to:**

  Replace the batteries.

  The Maintenance section provides specific instructions for this type of service.

  Any other modification in the equipment should be carried out by specialised personnel only.
- The negative of measurement is at ground potential.
- **Do not obstruct the equipment's ventilation system**.
- Use the appropriate cables with low radiation levels (for example, Televés' T100) for the signal inputs/outputs, especially when using high levels.
- Follow the **cleaning instructions** described in the Maintenance section.

1.2.- POWER SUPPLY

The **FSM 650** has two operation modes; external powering or battery powered.

1.2.1.- External powering

A DC adapter is provided with the equipment which allows you to connect the equipment to the mains, both for normal operation as well as for charging the batteries. There is a special compartment for it in the cover. To connect the equipment to the mains, connect the adapter to the power connector (31) located on the side of the equipment (see 2.2.- *Element description*).

When the equipment is connected to the mains, the **Ext. Sup. LED** (11) lights up (see 2.2.- *Element description*).

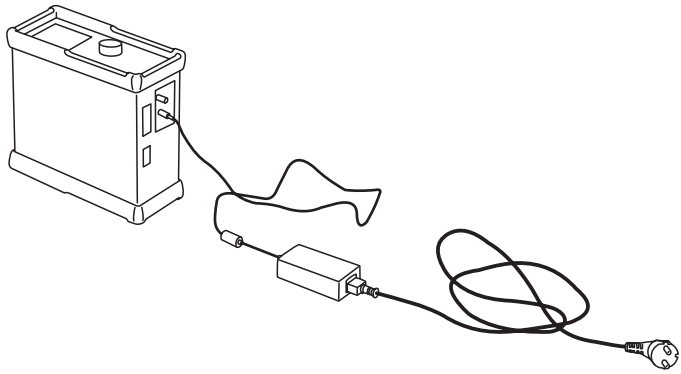


Figure 1.- Connection to the mains

1.2.2.- Battery powered

The **FSM 650** comes with one 12V Ni-MH battery. This battery, using an average consumption, can power the equipment for more than four hours.

The equipment features a complicated control system for charging and discharging the batteries which optimises their duration and life, and this in turn means that the equipment can use this form of powering without any abrupt decrease in the length of time.

To charge the batteries, connect the equipment to the mains using the DC adapter (see previous section). If the batteries have less than 40% of their optimal power, the recharging process will begin automatically.

However, the battery can be charged even if it has more than 40% of its optimal power by simply plugging the equipment into the mains and pressing the button for 3 seconds. To stop charging, press the same button again for 3 seconds.

While the equipment is charging the battery, the **Battery** (11) LED will flash.

In any case, the equipment will stop charging once this is complete.

The equipment is constantly monitoring the status of the batteries and it informs the user of their status via an LED icon (**Battery** (11)) and an audio signal.

The icon is a battery with a blue outline. When the batteries are fully charged, the inside part of the battery icon is completely yellow. As the battery discharges, the level of the yellow colour drops leaving the rest of the battery icon empty (transparent). The icon has 5 different levels, which represent the approximate status of the battery:

- Batteries charged <20% (icon totally empty)
- Batteries charged between 20 and 40%
- Batteries charged between 40 and 60%
- Batteries charged between 60 and 80%
- Batteries charged >80% (icon totally full)

The LED indicates the state of the batteries during the recharging process: when the equipment is connected to the mains, if the batteries are more than 40% full, they will not get charged (unless the recharging process is forced).

If the batteries are less than 40% full, the recharging process will begin. When the batteries are <20% full, the LED will light up for 500 msecs and will switch off for 2.5 secs. As they get recharged, the time that the LED is on will increase and the time that it is off will decrease. When the batteries are 80% full, the LED will light up for 2.5 secs and will switch off for 500 msecs. When they are completely full, the LED will remain on until the equipment is used.

Note: *If the temperature is too high, the charging process will not begin, and if this process is already underway, when the temperature reaches a certain level, the process will stop and will start again once the temperature has returned to an appropriate level*

When the external powering is disconnected, the LED will turn itself off.

If the batteries get below a certain level, the equipment will begin to make a buzzing noise and a message will appear onscreen indicating a low battery. If the battery level continues to drop, the equipment will indicate this every 10 seconds, warning you that it will shut down unless you connect it to the external powering before 30 seconds have passed. If this is not carried out, the equipment will shut down.

On the equipment's information screen (see 3.3.2.6.- *Information about the equipment*) you can also see information about the voltage of the batteries.

Note: *When the battery has run out completely, the recharging process will take about 10 hours if the equipment is switched off during the entire process. If the equipment is on, the ssame process will take about 18 hours*.

Note on charging the battery:

⇒ Whenever possible, it is advisable to recharge the batteries completely. In other words, when the recharging process begins, do not interrupt it, until the batteries are 100% full.

⇒ If you are not going to use the equipment for a while, the battery level should not be very low. The batteries will discharge slowly while the equipment is not in use, therefore it is advisable to carry out a recharging process every 2 or 3 months if the batteries are stored in a room temperature of 25ºC. The higher the room temperature, the more frequent the recharging process.

⇒ The batteries should be recharged when they are inside the meter and using the DC adapter that is provided with the equipment or by providing a current within the specified range (12 - 14,8 V). This is the only way to ensure that the batteries have a long life.

⇒ For the batteries to work properly, it is necessary to charge and discharge the batteries completely various times.

1.3.- START-UP

The equipment has a battery already inside, so to switch the equipment on, press the ON button (10). You do not need to connect the equipment to the mains. Once this button has been pressed, all of the LEDs will light up for a few seconds. During this time, the Televés logo will appear onscreen as will the equipment's software version.

Once a few seconds have passed, all the LEDs will switch off, except the ON LED.

If the equipment is connected to the mains, the **Ext. Sup.** (green) LED will also stay on. If the batteries are less than 40% full, these will begin to recharge and the **Battery** LED (green) will light up as can be seen in the previous section.

2.- PRODUCT DESCRIPTION

The **FSM 650** is a portable meter with a 5" coloured screen which features all of the basic functions that are necessary to guarantee a high level of quality in an analogue or digital RTV installation.

The meter's robustness and the fact that it is easy to use together with the long duration of battery life (more than four hours with a combined average consumption) make it an excellent portable device.

The meter includes the possibility of using several types of units: **dBµV**, **dBmV**, **dBµV/m** (calculated for a Televes DAT45 antenna and 10 metres of T100 cable) and **dBm**. The meter is configured by default to measure in dBµV.

It has been designed to carry out measurements both in analogue channels (level, C/N, V/A), as well as in digital channels (power, C/N, BER, MPEG), and both in the terrestrial band (47-860 MHz) as well as in the satellite band (950-2150 MHz). Also, when in spectrum mode, it is possible to see the GSM band (860-950 MHz) and the return channel (5-47 MHz) **which means that the spectrum analyzer works in all the frequencies between 5 and 2150 MHz**, and is able to carry measurements in these frequencies.

Incorporates the **MPEG2 demodulation function (standard resolution)** in open **COFDM**, **QAM**, **QPSK** and **DVB-S2**.

The multimeter also measures **DVB-S2** signals. The measurement used to evaluate the quality of the signal is the **Link Margin** (dB).

Three additional measurements are provided: **CBER**, **MER** and **BCHBER** (the bit error rate of the BCH error correction algorithm).

The multimeter provides you with the functionality of the **NICAM digital audio** standard, together with an additional digital measurement known as **MER** for **QAM**, **COFDM** and **QPSK** modulations. You can also visualize the constellation in **QAM**, **COFDM** and **DVB-S2**.

The meter allows you to analyse Wireless Local Area Networks (WLAN) operating at a frequency of 2.4 GHz.

The meter lets the user **measuring DAB signals** in terrestrial and satellite. The meter, once locked onto a DAB channel **displays the BER measurement, the SN, information about the service provider**, as well as a **list of services** that can be selected an any moment

By means of some new functions, you will be able to create up to **250 memories** of your most commonly used measurements, and make them automatic via the execution of Macromeasurements. The results will be displayed in up to **100 different DATA LOGS with hundreds of different outlets and each one of these with tens of measurements.** These measurements can then be downloaded onto the PC thanks to the included **DataLogger** program (FSM Management).

If you wish, after executing a Macromeasurement or a SCAN&LOG, the **FSM 650** can process the information obtained to **automatically carry out an evaluation of the signal quality** present at the socket.

You can also view, record and edit graphs, and use the FSM Management application to organize them.

The menu functions are in a hierarchic order, so that they are very easy to find and use.

Another important characteristic is that the menu functions are displayed on the 5" coloured TFT screen. Thanks to the OSD function, we can see the images of the tuned channel (or the spectrum), the menu functions and other information windows onscreen, as can be seen in the following figures:

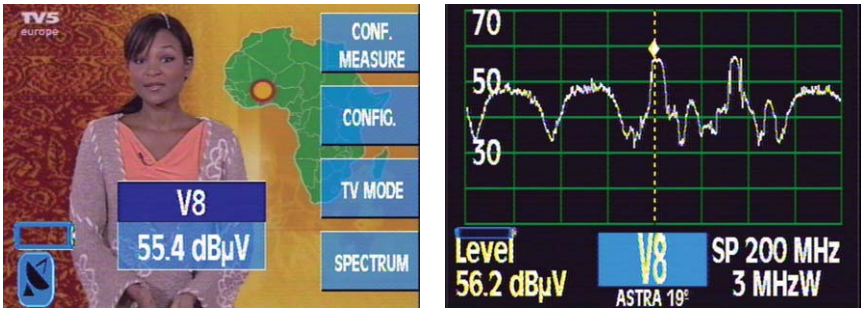


Figure 2.- TV mode or spectrum

To the right of the screen, you can see the buttons that are used to access the function or submenu that is being indicated at that moment on the screen.

2.1.- SPECIFICATIONS

Next, you can see a list of the main specifications of the **FSM 650**.

Monitor:

Screen TFT 5" colour

Standard Multistandard: PAL (B, G, D, K, I), SECAM (B, G, D, K, L)

Synchronism burst Onscreen presentation via the OSD function

Synchronism 50 Hz

Video signal

- **External video input**: SCART (on, off and auto)
- **Sensibility**: 1Vpp (75 ohm) positive video
- **Video output**: SCART (composite video)

Sound

- **Input** SCART
- **Outputs** SCART and built-in loudspeaker
- **Demodulation** AM, FM and NICAM
- **De-emphasis** 50µs/75µs
- **Subcarrier** Variable from 4 to 9 MHz with a 10 KHz resolution both for terrestrial as well as for satellite signals.

  Terrestrial: according to the selected standard:

Standard	PAL B/G	PAL D/K	Pal I	SECAM B/G	SECAM L	SECAM D/K
Subcarrier	5.50 & 5.74	6.50 & 6.74	6.00	5.50 & 5.74	6.50 & 5.85	6.50 & 5.85

  Satellite: 7.02 and 7.20 MHz, regardless of the standard

Mechanical specifications:

Anti-shock protective holsters

Weight: 5.5 Kgs (without bag).

Size: 280 x 130 x 310 (protective holsters includes)

External units and batteries:

Powering of external units: Via the RF connector

Powering of the preamplifiers and LNB: Voltage (12/17/24 V) and 22 KHz tone (on and off)

Batteries: 1 battery Ni-MH 12V and 6 Ah.

Automatic shut down: Programmable after a period of inactivity from between 1 and 59 min. (15 min by default)

Battery status:	An LED, an onscreen icon and a buzzing noise indicating a low battery.
External powering connection:	Via a DC adapter provided with the FSM.
External powering:	12 - 14,8V
Maximum consumption:	35W

Batteries recharged using provided adapter for car lighter

Measurements:

Measurement units:	dBµV, dBmV, dBµV/m (calculated for a Televés DAT45 antenna and 10 metres of T100 cable) and dBm.
	Numerical indication onscreen using the OSD function
Frequency range:	Terrestrial band: 47-860 MHz
	Satellite band: 950-2150 MHz
	Return band: 5-47 MHz
	GSM band: 860-950 MHz
	WLAN band: 2412-2484 MHz
Frequency resolution:	50 KHz terrestrial and 100 KHz satellite
Resolution level:	0,1 dB
Typical precision:	± 1 dB terrestrial and ± 2 dB satellite
Reading and compensation:	Automatic
Dynamic range:	Greater than 50 dB
Analogue:	Level (numerical indication, bar and audio signal), C/N, V/A
	representation of the synchronism burst
Digital:	Channel power, C/N, BER (COFDM, QAM, QPSK, DVB-S2, DAB), MPEG2 standard resolution (CODFM, QAM, QPSK, DVB-S2), Constellation (QAM, COFDM, DVB-S2) MER (COFDM, QAM, QPSK, DVB,S2) Link Margin (DVB-S2), S/N (DAB).

Level measurement:

Measurement margin:

Terrestrial bands and FM: 15 dBµV to 130 dBµV

Satellite band: 20 dBµV to 120 dBµV

Measurement bandwidth: 250 KHz (terrestrial band) and 3 MHz (satellite band)

Spectrum representation:

Resolution filters:	100 KHz, 250 KHz, 1 MHz and 3 MHz automatically and manually selectable
Horizontal span:	Terrestrial band: selectable (8, 16, 32, 48, 96, 192, 496 MHz) and Full Span
	Satellite band: selectable (25, 50, 100, 200, 512 MHz) and Full Span
Reference level:	Terrestrial band: selectable from 60 and 130 in steps of 10
	Satellite band: selectable from 60 and 120 in steps of 10
Attenuator:	Automatic

Environmental working conditions:

Height:	Up to 2000 m
Temperature margin:	From 0 to 40 º C
Maximum relative humidity:	80 % (Up to 31ºC), in a linear decrease until 50% at 40º C.

Accessories included:

1 - CD software (FSM Management)
1 - Cable series RS-232
2 - Adapter “F” female / ”F” female (139053)
2 - Push on adapter “F” male / ”F” female (140130)
1 - Adapter “F” female / ”CEI” male (140540)
1 - Adapter “F” female / ”CEI” female (140541)
1 - Adapter “F” female / ”BNC” female (140592)
1 - DC block “F” (140023)
1 - Adapter DC 12V external
1 - Car lighter recharger 12V (140093)
1 - Protective case for travelling
1 - WLAN antenna

2.2.- ELEMENT DESCRIPTION

The front panel features the following elements:

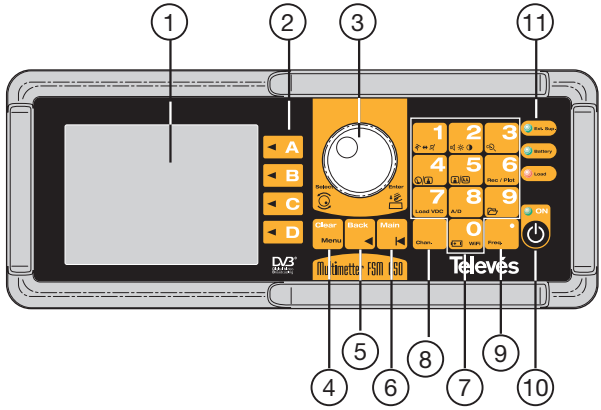


Figure 3.- Front panel

(1) Monitor

TFT 5" colour screen

(2) Short cut buttons

Each of these buttons correspond to one of the menu functions that can be seen onscreen at that moment.

(3) Rotating knob

Depending on where we are on the menu, there are two different functions. For example, if there is a parameter selection window open, it will allow us to change from one option to another and to select an option by ***pressing it*** Enter.

It can also be used to change channels (channel mode) o to tune another frequency (frequency mode).

In the following sections, when the meter's functions are explained in detail, the symbol will be used to indicate the parameters that are selected using the rotating knob.

(4) Clear/Menu

This makes the menu buttons appear and disappear from onscreen. It is also used to close the windows that appear in the middle of the screen (measurement windows, parameter selection windows, etc).

(5) Back

This button has two functions: if the user is entering some data using the number pad (frequency or password), then this button is used to erase the last digit entered, however in all other cases this button is used to return to the previous menu.

(6) Main

By pressing this button, the user returns to the main menu.

(7) Number pad and short cut buttons

The number pad allows us to enter the frequency that we want to tune. In the following sections, the symbol will be used to indicate the parameters that can be configured using the number pad.

Some of the buttons on the number pad are also short cut buttons to the most commonly used functions.

The following sections explain all of these functions in detail. The functions with a short cut button will have a picture of this button beside them.

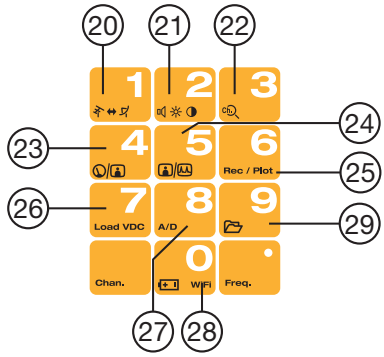


Figure 4.- Main Keypad

(8) Chan

Selects the channel tuning mode. If there is a measurement window open, the tuned channel will be displayed in it. If there is no window open, the previous measurement window will be automatically opened.

(9) Freq

Selects the frequency tuning mode. If there is a measurement window open and the equipment was previously in the channel tuning mode, when you press the **Freq** button, the information regarding the tuned channel disappears and the video carrier frequency of that channel appears in its place. **Once the equipment is in frequency tuning mode, if we press this button again, the tuned frequency is erased and we can enter the frequency that we wish to tune using the number pad**. To enter the point which separates the decimal part of the value, we should press this button again. To confirm the frequency that we have just entered in the number pad, we should press the rotating knob

.

(10) ON

Starting-up button. To switch the equipment off, press this button for more that 2 seconds.

(11) Status LED´s

Ext. Supply: this indicates if the equipment is being powered externally.

Battery: this indicates if the batteries are being charged, and if this is the case, the battery level. While the batteries are being charged, the LED will flash.

Load: this indicates if the equipment is powering external elements. This is the only LED that is red so that it clearly warns the installer of this situation.

ON: this indicates if the equipment is switched on.

(20) Switching bands (Button1)

It immediately switches the frequency band from terrestrial to satellite and vice versa, both in TV mode and in spectrum mode.

(21) Access to the monitor parameters (Button 2)

This lets the user control the brightness, contrast, saturation and volume. Each time this button is pressed, the following parameter is selected.

(22) Channel search (Button 3)

This automatically tunes the next channel with a carrier level that is higher than the level selected by the user (see section *3.3.3.3.- Channel search*).

(23) Show / hide the previous measurement window (Button 4)

If there is a window of an analogue measurement open (V/A or C/N), when this button is pressed, it will close. And if we press it again, it will appear again, even if we are in another place in the menu. However, the level measurement is somewhat different. If the abbreviated level measurement window is open (this only displays information on the tuned channel or frequency and the measured signal level) and we press this button, the extended window will appear, which displays all the data of the abbreviated window as well as information on the standards, the audio carrier frequency etc.

(24) Switching analyser / TV viewing modes (Button 5)

This lets you change from the TV mode to the analyser mode and vice versa.

(25) Printing measurements (Button 8)

This automatically prints the measurement on an RS-232 printer.

In Analyser mode, you can access the graph menu and save the graph that you are viewing.

(26) External powering (Button 7)

This opens the window that displays information on the powering of external units. These units are powered via an input F connector.

(27) Selecting analogue / digital measurements (Button 8)

This lets you change from the analogue to the digital measurements and vice versa. The menus are automatically located on the parts that correspond to the analogue or digital measurements. When the analogue measurements are selected, the level measurement window is opened, and when the digital measurements are selected, the power measurement window is opened and the picture onscreen disappears.

(28) WLAN / Battery charging (Button 0)

By pressing this button for more than 3 seconds, the battery will begin recharging, whatever the battery level may be, as long as the meter is connected to the mains. The user can abort the recharging process by pressing this button again for more than 3 seconds.

Note: *If the temperature is too high, the charging process will not begin, and if this process is already underway, when the temperature reaches a certain level, the process will stop and will start again once the temperature has returned to an appropriate level*

(29) Memories Logger (Button 9)

This lets you directly access the Memory lists, the Macro Measurements, Data Logs and Graphics.

Side view:

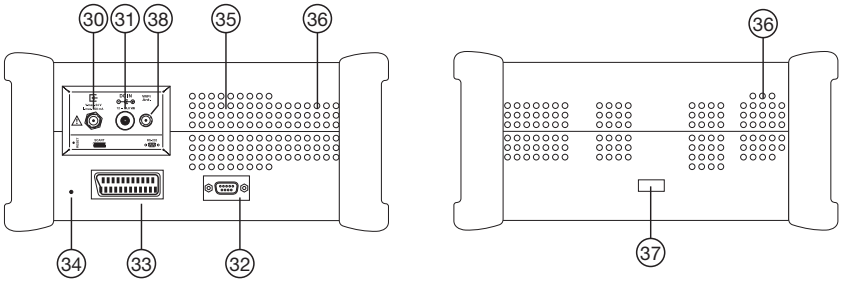


Figure 5.- The connectors on the side panels

(30) RF input

Input connector for the signal with an impedance of 75 ohm.

(31) Powering

Input for the external powering of 12 - 14,8 V⎓

(32) Serial port

Connection to the PC in order to use the FSM Management programme or for the upgrading of the meter's software.

Connection printer RS 232.

(33) SCART

(34) Reset button

When the user presses this button, it restarts the equipment. When you do this, the equipment retrieves the same configuration that it had when it was switched off propertly for the last time.

To reset the equipment, the user should use an object that is not sharp or particularly pointed, and gently press the button.

(35) Loudspeaker

(36) Ventilator

(37) Switch for configuration of batteries

(38) WLAN antenna connector

3.- HOW TO USE THE PRODUCT

3.1.- THE MENU

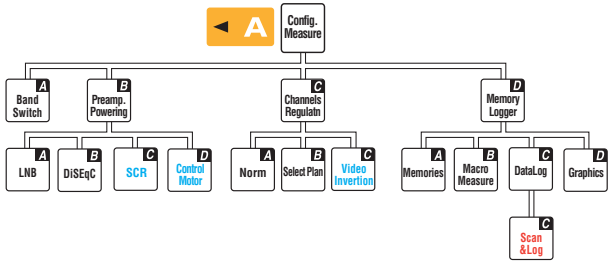
As explained previously, the different functions of the equipment have been placed in hierarchical order, so that they are very user-friendly.

The menu texts appear onscreen, superimposed over the picture, which can be the demodulated picture from the tuned TV channel (TV mode) or the spectrum (analyser mode). If in TV mode, the background of the text windows is slightly transparent so that it is still possible to see the picture. If we are looking at the spectrum, the menu texts are invisible by default, until the Clear Menu button is pressed or until one of the buttons ◄A , ◄B , ◄C or ◄D are pressed so that in this way, you can still see the spectrum properly.

If the equipment is in TV mode, when the user wants to change a parameter or see a measurement, once the corresponding function has been selected, a window opens onscreen with a transparent background.

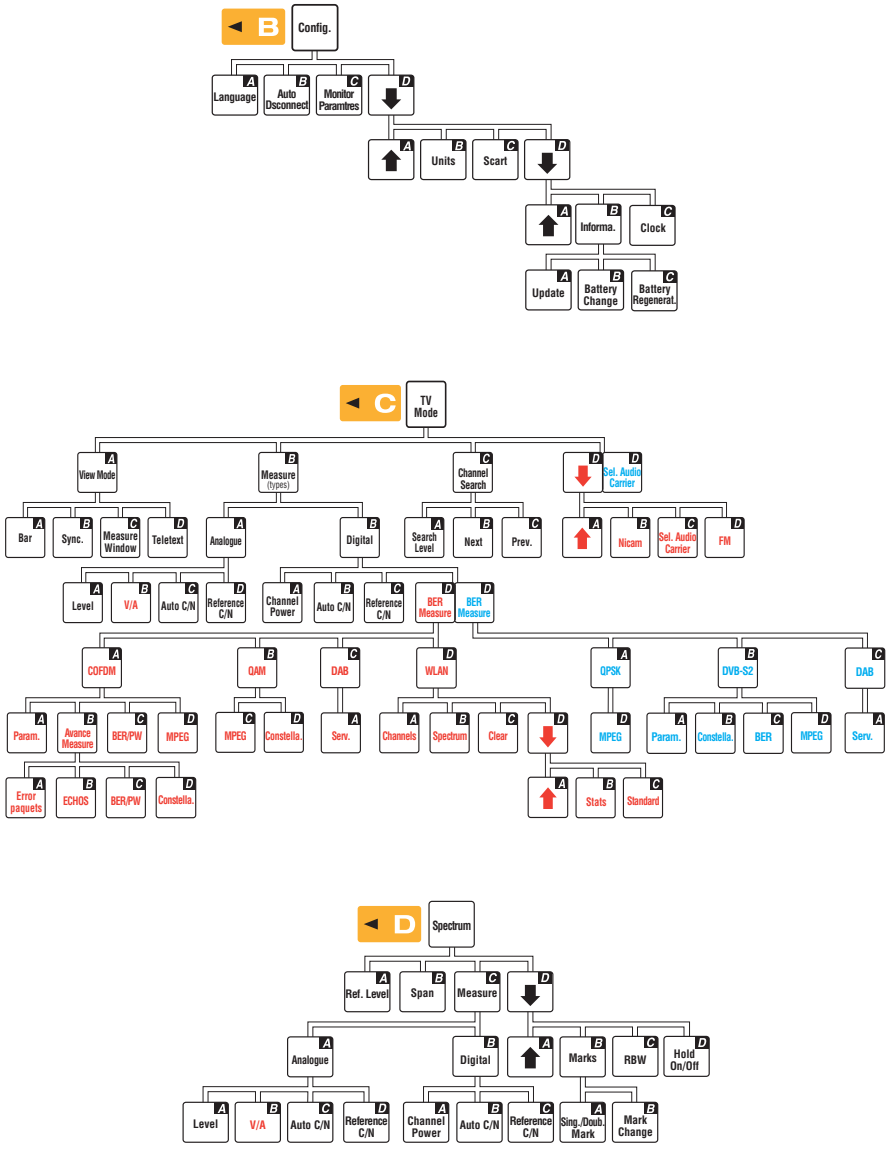
If however, the equipment is in analyser mode, the measurements appear on the lower part of the screen, so that the user can see the measurement and the spectrum at the same time.

Here you can see a diagram which shows the equipment's functions in their hierarchical order:



The functions with blue text are the measurements for the satellite band.

The functions with red text are the measurements for the terrestrial band.



The functions with blue text are the measurements for the satellite band.
The functions with red text are the measurements for the terrestrial band.

3.2.- TUNING MODES

The **FSM 650** has 2 tuning modes: by channel or by frequency. To select one or the other, use the **Chan.** (channel tuning) and **Freq.** (frequency tuning).

If using the channel tuning option, the measurements taken will be done on the video carrier of that channel. For example, if the selected plan is the CCIR, and the tuned channel is S01, the video carrier frequency is 105.25 MHz. Therefore, when the level is measured, the video carrier frequency level will be measured. If, for example, we want to measure the C/N, the equipment will automatically look for the video carrier frequency and carry out the measurement in this frequency. The same will happen with the V/A ratio measurement.

When a measurement window is open, and we press the **Chan.** button, we will go to the channel tuning mode, and we will see the tuned channel onscreen. If we turn the knob, the next channel will be automatically tuned and the new measurement will appear in the window.

On the other hand, if the frequency tuning mode has been selected, the measurements will be carried out in the frequency that is indicated. For example, if the C/N measurement is selected, the carrier level will be measured in the frequency selected by the user, which may not coincide with the video carrier of a channel. When a measurement window is open, and when we press the **Freq.** button we will go to the frequency tuning mode and the text with information about the frequency will be highlighted (dark background). In this way, we will be able to vary the frequency using the rotating knob (variations of 50 KHz in the terrestrial band and 100 KHz in the satellite band). If we press the **Freq.** button again, the information about the frequency will disappear and we will be able to enter the frequency using the number pad. To confirm the frequency press the rotating knob.

If the frequency tuning mode is selected and we press the **Chan.** button, we will access the channel tuning mode, and the window that is open at that moment will display the name of the channel that that frequency belongs to (according to the channel plan that is selected).

If the channel tuning mode is selected and we press the **Freq.** button, we will access the frequency tuning mode and the frequency that appears is the video carrier frequency of the channel that was tuned.

3.3.- FUNCTIONS

This sections explains all of the meter's functions in detail.

The main menu has the following options:

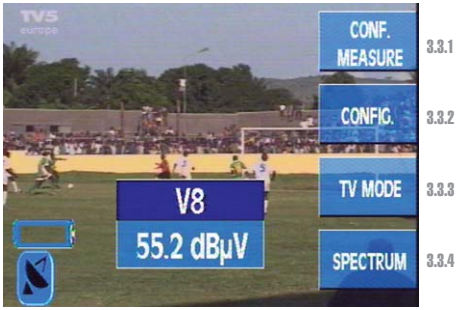


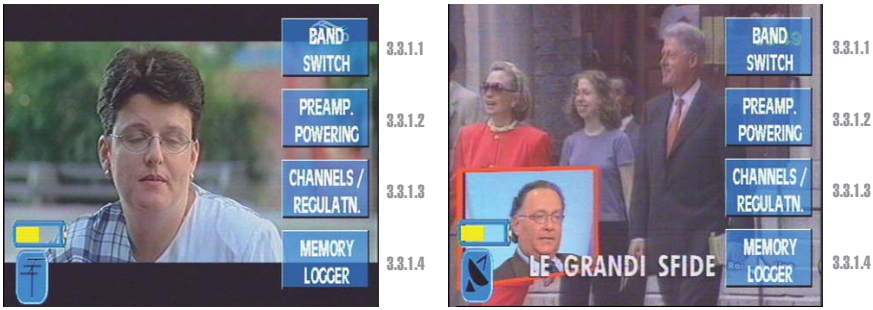
Figure 6.- Main menu option

3.3.1.- Measurement configuration

By using the functions in this menu you can set the parameters that affect the measurements that you are going to take.

All of the windows that are opened with the different functions of the “Measurement Configuration” menu can be closed by pressing the **Clear** button.

Within this option we have the following submenu:



Terrestrial band Satellite band

Figure 7.- Submenu options

3.3.1.1.- Band switching (short cut button 1)

This lets you switch bands from terrestrial to satellite and vice versa. When the band switching occurs, the icon at the bottom left-hand corner of the screen also changes at the same time. If the terrestrial band is selected, the icon that appears is an antenna for terrestrial signals , and if the satellite band is selected, the icon the appears is an antenna for satellite signals .

3.3.1.2.- Preamplifiers (terrestrial band) **/ LNB and Preamplifiers** (satellite band). Short cut button 7 Load VDC :

It is acceded to the menu for the configuration the power to preamplifiers and LNB.

When turn ON the measurer, the option that appears selected will be always OFF.

This menu varies depending on which band is selected (terrestrial or satellite).

In the **terrestrial band**, a window will appear in which the installer can select the power and the tone of the preamplifiers:

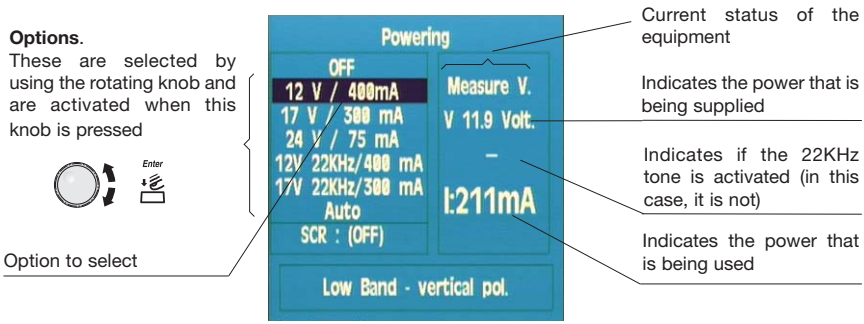

Options.
These are selected by using the rotating knob and are activated when this knob is pressed
Enter
Option to select
Powering
OFF
12 V / 400mA
17 V / 300 mA
24 V / 75 mA
12V 22KHz/400 mA
17V 22KHz/300 mA
Auto
SCR : (OFF)
Measure V.
V 11.9 Volt.
–
I:211mA
Low Band - vertical pol.
Current status of the equipment
Indicates the power that is being supplied
Indicates if the 22KHz tone is activated (in this case, it is not)
Indicates the power that is being used

Figure 8.- Preamplifier powering

If the **satellite band** is selected, when the *preamplifier powering* option is pressed, the following submenu will appear:

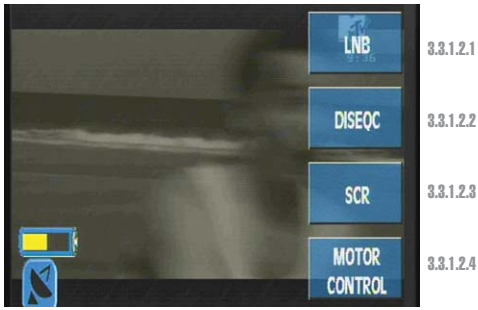


Figure 9.- Options available in the preamplifier powering submenu

It is worth noting that when a voltage is activated for the powering of an external device, the red led will light up (**Load**). If this led flashes, it is indicating that there is an error.

Also, the programming of the voltage depends on the band that is selected at the time, so that if 24V is selected in the terrestrial band, this does not mean that this voltage will pass to the satellite band.

3.3.1.2.1.- LNB (only satellite band):

When this function is selected, a window which is very similar to the previous one opens. The user can use this function to select the powering and tone of the LNB.

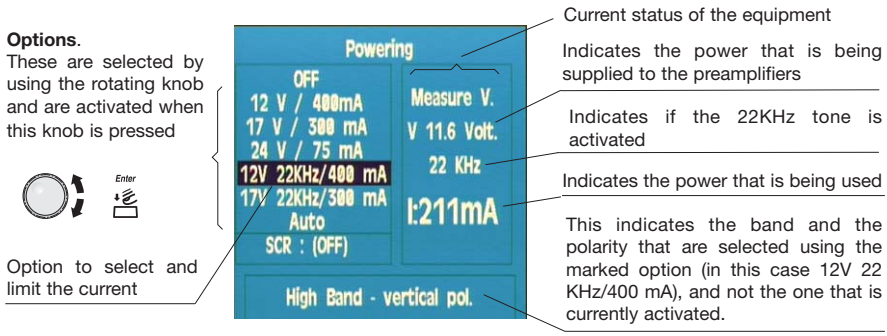

Options.
These are selected by using the rotating knob and are activated when this knob is pressed
Enter
Option to select and limit the current
Powering
OFF
12 V / 400mA
17 V / 300 mA
24 V / 75 mA
12V 22KHz/400 mA
17V 22KHz/300 mA
Auto
SCR : (OFF)
Measure V.
V 11.6 Volt.
22 KHz
I:211mA
High Band - vertical pol.
Current status of the equipment
Indicates the power that is being supplied to the preamplifiers
Indicates if the 22KHz tone is activated
Indicates the power that is being used
This indicates the band and the polarity that are selected using the marked option (in this case 12V 22 KHz/400 mA), and not the one that is currently activated.

Figure 10.- LNB powering

If in the satelllite band, the band (high or low) and the polarity (vertical or horizontal) that correspond to the selected powering and tone appear on the lower part of the windows

12V / 400mA	==>	low band, vertical polarity
17V / 300mA	==>	low band, horizontal polarity
24V / 75mA	==>	preamplifier powering
12V 22KHz / 400mA	==>	high band, vertical polarity
17V 22KHz /300mA	==>	high band, horizontal polarity
Auto	==>	this is only useful in the satellite band. It sets the appropriate power and tone automatically, according to the selected channel table, (using a universal LNB) to select the band (high or low) and the polarity (vertical or horizontal) to tune the selected channel.

The equipment continuously monitors the current in the F connector, and warns the user of any error by means of a message window that appears on top of any other window that may be open. The possible problems which may arise related to the powering of the external units are as follows:

- The equipment detects a current in the coaxial cable. In this case, the message that appears as a warning is "**Vext**". This situation should be avoided.
- When the equipment detects a shortcircuit, it emits an audio signal and the message that appears as a warning in this case is "**Shortcircuit**".
- In the same way, the equipment warns the user when the consumption is greater than the maximum amount permitted. The message that appears is "**Exceeded limit**". In the last two cases, the power is cut-off and it automatically tries again approximately every 3 seconds.

3.3.1.2.2. DiSEqC (satellite band only):

The Diseqc protocol lets you work with multiswitches that have up to 16 inputs. To do so, when the meter is in the satellite band, you must enable, in the powering menu, the current and tone that corresponds to the desired polarity and satellite band. As well as the chosen band and polarity, it is necessary to specify the satellite that we are going to receive the signal from (the multiswitches organise the different polarities in groups of four, and identify each group using the names SAT A, SAT B, ...). To do so, the user must enter into the DiSEqC section in the "Measurement configuration" menu and also in the "LNB and preamplifiers" menu. The following window will appear:

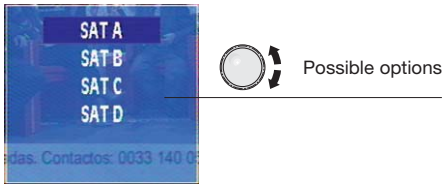


Figure 11.- Selecting the satellite in the multiswitch

The user must choose the appropriate satellite (a multiswitch with 8+1 inputs will only have satellite A and satellite B at its disposal).

Once this has been selected, press Enter. The equipment begins to send the command that informs the multiswitch about the chosen satellite, as well as the band and the polarity (which have been previously selected in LoadVDC).

When one of the DiSEqC inputs is chosen, if the powering of external units is off, an error message will appear.

When in satellite mode, using the short cut button 7 Load VDC it is possible to access simultaneously the LNB and DISEQC menus. We can choose the desired satellite using the buttons ◄ A, ◄ B, ◄ C or ◄ D.

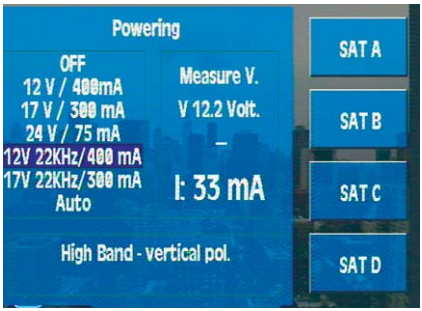


Figure 12.- Fast selection of the satellite

3.3.1.2.3.- SCR

The **FSM 650** is capable of controlling devices (LNB, multiswitches) compatible with the SCR protocol defined in the 50494:2006 standard. The basic purpose of this protocol is to divide the FI bandwidth (950MHz to 2150MHz) into user bands or “slots”. The number of wavelengths varies from one application to another, and the maximum is defined in the standard as 8. On the meter, these bands are defined from SCR0 to SCR7 and correspond to the frequencies shown in the following table:

SCR Channel	Frequency (Mhz)
SCR0	1680
SCR1	1420
SCR2	2040
SCR3	1210
SCR4	1680
SCR5	1420
SCR6	2040
SCR7	1210

(Using the ordering method defined in the standard).

In order to access this operating mode, the meter must be in satellite mode and powering the device. Otherwise the following message will be shown: "*No SCR, Vdc OFF*".

By pressing shortcut key

we enter the power options. At the bottom is an option to select the SCR.

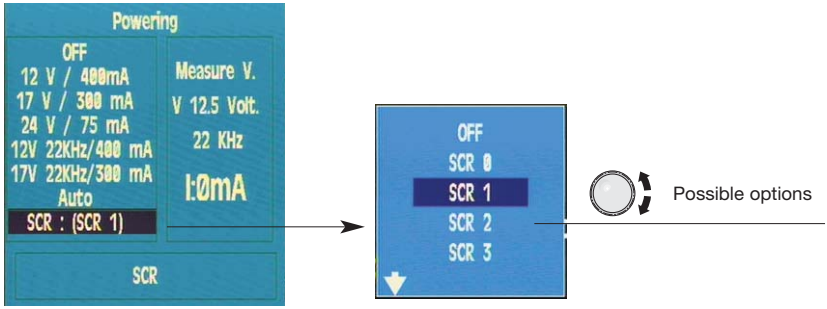


Figure 13.- SCR Option

With the SCR activated in analyser mode, the spectrum will be shown in blue, and will show information on the SCR channel selected.

The meter will automatically tune to the SCR frequency and show the two frequencies: the FI frequency and the SCR frequency.

The user may scroll through in FI and the meter will automatically carry out the necessary functions in order to visualise the signal correctly.

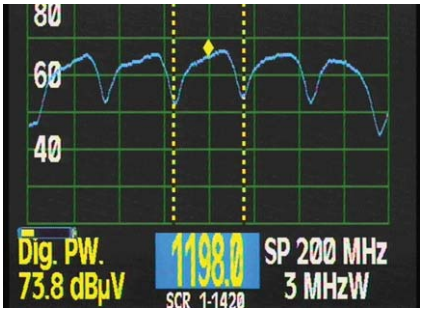


Figure 14.- SCR channel tuned

3.3.1.2.4. Motor Control

The **FSM 650** allows users to control the DiSEqC motors used to move mobile parabolic antennas.

This function is available in satellite mode and when the equipment is powering the LNB. If there is no power, the following message will be shown: "*Motor OFF, Vdc OFF*".

To access these functions, the following keyboard sequence must be used:

MAIN ⇒ Config Measurements ⇒ LNB and PREAMPLIF ⇒ MOTOR control.

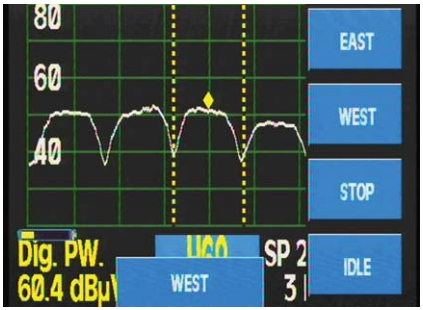


Figure 15.- Moving the parabolic antenna

EST: Allows the motor to move EAST. Each time the key is pressed it will correspond to one step in the movement of the motor (step motors). If the key is held down, successive sequences of movements will be performed until the key is released.

WEST: Motor movement to the WEST. Each time the key is pressed it will correspond to one step in the movement of the motor (step motors). If the key is held down, successive sequences of movements will be performed until the key is released.

STOP: This command stops the movement of the motor.

IDLE: Situates the motor in the reference position. This position will depend on the type of motor (usually 0º).

3.3.1.3.- Channels and Standards

3.3.1.3.1.- Standard

This allows you to select the colour standard. The standards that are available are as follows: **PAL B/G**, **PAL D/K**, **PAL I**, **SECAM B/G**, **SECAM L** and **SECAM D/K**.

The window that appears when this function is selected is as follows:

PAL B/G
PAL D/K
PAL I
SECAM B/G
SECAM L
Selectable options using the rotating knob
This indicates that there are more options. These will appear as we turn the knob.

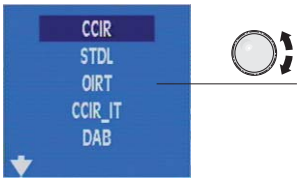
Figure 16.- Standard selection

3.3.1.3.2.- Select Plan

This selects the channel plan that the user wants to use. The options that will be available with this function will depend on the band that is selected:

Terrestrial band: CCIR, STDL, OIRT, CCIR-IT, DAB, SIM.7637, SIM.4009

Satellite band: ASTRA 19 HL, ASTRA 19 VL, ASTRA 19 HH, ASTRA 19 VH, ASTRA 19, HOTBIRD HL, HOTBIRD VL, HOTBIRD HH, HOTBIRD VH, HOTBIRD, HISPASAT HL, HISPASAT VL, HISPASAT HH, HISPASAT VH, HISPASAT, DAB, SIM.4008, SIM.4009, ASTRA 28, EUROBIRD, NILESAT, BARD 26, TURKSAT, EURASISAT, AMAZONAS, SIRIUS 5, THOR 1W, EUTELSAT W2.



Channel plans in the terrestrial band

Channel plans in the satellite band

Figure 17.- Channel plans

Note: *The ASTRA 19, HOTBIRD, HISPASAT, plans include all the channels in both bands and both polarities, ordered according to their frequency. If the LNB needs to be powered, it is advisable to select the Auto option in the power supply menu for the preamplifiers and the LNB.*

3.3.1.3.3.- Video invertion

This function lets you select if the video signal that comes from a satellite band is inverted (**ON**) or not (**OFF**). By default, this option is OFF.

It is useful when watching the video of satellites from the C band. When using an SCR converter to correctly view analogue channels, invert video must be selected (ON).

Figure 18.- Video polarity selection

3.3.1.4.- Memory Logger.

This section describes how to access a series of functions that let you turn the majority of processes that you carry out with the meter into automatic operations.

On screen you will see a window with a list of the meter memories. If no memories have been recorded, the window will be empty.

Figure 19.- List of available memories

Using this menu, it is also possible to access the graph functions, however this will only happen when the meter is in analyser mode. If you do not dispose of the graph option, the menu key will appear with a shadow.

3.3.1.4.1.- Memories. Short cut button 9 :

The **FSM 650** lets you save up to **250 different configurations** (memories) for your equipment, which you will be able to retrieve very simply.

The measurer is able to store any state in which is as mode, norm, measurement type, etc.

List of stored memories
Information about the selected memory: satellite band, TV mode, channel plan HOTBIRD, channel 16, level measurement, norm: PAL B/G, audio carrier, powered preamp.
MED2 14
QPSK23
TDT 40
TDT 63
TDT 66
SAT TV HOTBIRD 16-LEV
PAL B/G OFF - 7.02 MHz
Load VDC 17V 22KHz
ENTER to recover the memory
SAVE
DELETE
EDIT
Selected memory
From the main memory menu, it is possible to select any of the memories on the list.
Enter
By pressing button, the equipment retrieves the configuration corresponding to this memory.

Figure 20.- List of available memories

To configure the equipment according to the stored parameters in a specific menu, simply press the 9 button (or go to the CONF. MEASURE => MEMORIES LOGGER => MEMORIES menu), select the desired memory from the list and press Enter.

If there isn't any memory in the meter, the message "*NO MEMORIES*" will appear onscreen.

By default, the meter has two memories called **INTEG0** (C/N Auto, Analogue TV mode, 7,5 Mhz, 6.0 Mhz Bandwidth) **INTEG2** (C/N Auto, Analogue TV mode, 22.65 Mhz, 1.5 Mhz Bandwidth).

These two memories should be used together with the return channel simulator, ref. 7637, in position 0 and 2. The equipment also includes the channels plan of this simulator.

These memories enable the analysis of the Return Channel, and have been especially designed for Televés Integra installations. Both configurations will be treated similarly to the memories defined by the user, and because of this, they can be edited or eliminated.

3.3.1.4.1.1.- Save

To save a specific memory, place the meter in the desired configuration and press 9. Use the ◄ A button to select the MEMORIES function. The menu from the previous figure will appear. Now press the **SAVE** button. The list of memories will be located at the end of this list and the name of the following free memory will flash on and off.

By default, the name of the memory that appears is always **MEM** followed by **three digits** ordered according to their values, but the user can name each memory as desired.

There are four options:

1.- Press Enter to accept the **name** that appears **by default**.

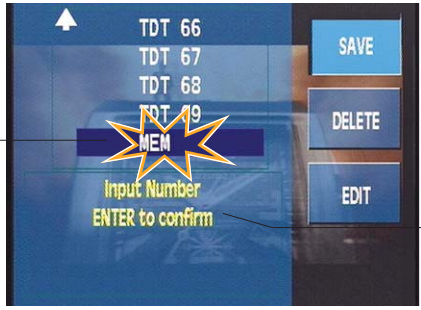
2.- If we want to **change** the **digits** only, we simply need to **press the desired numbers** on the number pad.

3.- If we want to **write over** a memory in the list, we need to use the rotating knob to reach the memory. Once here, we should press Enter.

4.- If we want to **change the name** of the memory, press the **EDIT** button.

First free memory. Flashing digits with the lower disposable number.

Press Enter to save.



On the lower part of the window, the instructions that the user must follow to save the memory appear.

Figure 21.- Saving a memory

When the user confirms that s/he wants to save the memory, the message "*MEMORY SAVED*" will appear onscreen.

The **maximum number** of memories that the meter can store is **250**. If the memory capacity is full, the message "*MEMORY FULL*" will appear onscreen.

The **FSM 650** allows you to store the DiSEqC command in the satellite memories. When we use LNB feed to record a satellite memory, the equipment will give us a choice of DiSEqC OFF or any of the 4 types of DiSEqC. (A, B, C, D). Using the rotating knob, we select the option and press the Enter button.

Figure 22.- DiSEqC Options

We use this function mainly to measure installations with a large number of points, and a multi-switch DiSEqC selectable SAT TV distribution system.

Each time the Macromeasurement is executed, the meter will **automatically generate the appropriate DiSEqC commands,** and will store the measurements, leading to significant time savings in measuring this type of installation

3.3.1.4.1.2.- Delete

When you want to delete a specific memory, press the **DELETE** button. Next a new window appears where you can see the list of the available memories.

Figure 23.- Deleting memories

Use the rotating knob to move through the list. When you find the memory you want to erase, press Enter, and this memory will be highlighted.

If you want to select all the memories in the meter, you can use the **SELECT ALL** option, so that all the memories are highlighted.

When you have finished selecting, press **CONFIRM.**

When the user confirms that s/he wants to erase a memory, the message "*MEMORY ERASED*" will appear onscreen.

3.3.1.4.1.3.- How to Edit a Name

This function enables the user to modify the name of any memory, whether it has been saved or whether it is a new memory that the user wishes to save.

If it is a memory that is already on the list, press the **EDIT** button and then, using the rotating knob, select the memory name that you want to modify. Press Enter to accept.

The first letter of the name will start flashing thereby indicating that this is the letter that is to be edited. By turing the rotating knob, the rest of the letters in the alphabet including the numbers from 0 to 9 will appear. The "_" indicates a blank space, in other words, once the memory name has been saved, it will be sustitued by a blank space. Once the letter that you want appears in the position desired, press Enter and begin the process again with the following letter in the name.

If you want to return to the previous letter, press the **Back** button.

The **name** of **each memory** should have **between 1 and 6 characters**. Once the 6 characters

have been edited, the process has finished. If the proposed name does not have 6 characters, it will be necessary to fill in the remaining spaces with blanks ("_").

If re-naming a memory that already exists, and if the new name has less characters than the old name, the characters that you wish to erase should be replaced with "_" (in other words, blank spaces).

If you are editing a memory that you are saving, press **EDIT** when the name proposed by the equipment is flashing. From now on, the process will be as described in the previous paragraph.

If you are trying to save a memory with the name of another memory in the list, the equipment will warn you. You can confirm the action by pressing Enter (in this case, the old memory will be erased) or you can cancel the action. To do so, simply rotate the knob (the name will disappear and the process will begin again).

It is not possible to save a memory with a name consisting of blank spaces only. In this case, the meter will display a message indicating that the name is incorrect.

When the user confirms the modification of the name of a memory, the message "*MEMORY EDITED*" will appear onscreen.

3.3.1.4.2.- Macromeasurements

A MACROMEASUREMENT is a group of a specific number of memories (different measurements), that the meter will be able to execute automatically and add the results to a specific measurement LOG. You can configure **up to 100 different MACRO MEASUREMENTS!** (automatic measurements with different memories).

The meter can carry out measurements from a list of memories whenever necessary, and then let the user view the results on the meter, or let the user download these measurements to the PC.

Conceptually, the meter can create the register per LOG and at the same time, in groups of outlets.

A DATA LOG is the list of results (measurements) that are obtained when a MACROMEASUREMENT is executed automatically, once or various times (different outlets in the same installation). The meter stores, at the same time **up to 100 different DATA LOGS !**. The equipment proposes a default name to identify the LOG. This name consists of a name (LOG) and the macromeasurement that was used.

Each DATA LOG (depending on the number of DATA LOGS that we have) can store the results of hundreds of different outlets, each one with tens of measurements. For example:

No. DATA LOGS	No. of outlets/ DATA LOG	No. of Memories (measures) / outlet	No. of MEASURES
1	440	70	30800
2	303	50	30300
3	100	100	30000
5	110	54	29700
10	40	70	28000

To execute a Macromeasurement quickly press the short cut button

, then the option **MACROMEASUREMENTS**. The window will display a list of available Macromeasurements. If no Macromeasurement has been created (*see section 3.3.1.4.2.1.- New Macro*) the window will be empty. Use the rotating knob to highlight the one we want to execute. The content of each Macromeasurement is displayed at the bottom of the window.

If there is no macromeasurement saved in the meter, the message "*NO MACROS*" will appear onscreen.

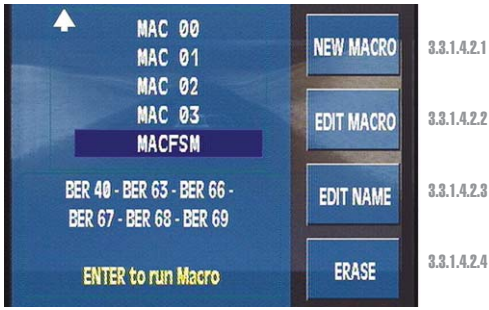


Figure 24.- Macromeasurements

When the Enter is pressed, the MACRO OPTIONS menu is displayed.

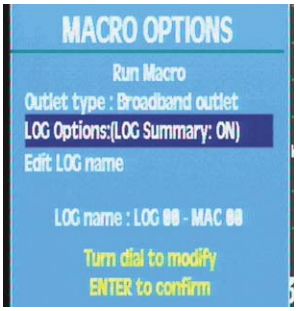


Figure 25.- Macro options

Use the rotating knob to choose the different options of this menu:

- Run Macro. Starts the execution of the selected Macromeasurement. If the selected macromeasurement does not contain any memory, the meter will display the following message "*MACRO EMPTY*".

Figure 26.- Execution of a Macro

- Outlet type. There are two choices, by default the **Filtered outlet** is used. The equipment establishes an execution order of the Macromeasurement. During the Macromeasurement and before carrying out the measurements that correspond to the satellite, the Meter will display a message warning that the connector of the separating outlet should be changed in order to continue executing the Macromeasurement.

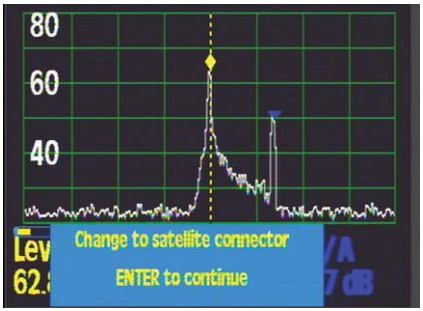


Figure 27.- Change to satellite connector

The other possibility that can be chosen using the Enter button is the **Broadband outlet** where the equipment carries out the Macromeasurement in both bands with no interruptions. If you press Enter a drop down menu will appear where you can choose an option using the rotating knob and accept your choice by pressing Enter.

During the executing process of a Macromeasurement a window will appear onscreen with information about the process. When the process is completed, the meter will make a warning noise and will propose a number for the outlet that was measured. This number will be the lowest avaible. The user can edit the name of the outlet by pressing the A button (CHANGE OUTLET N.).

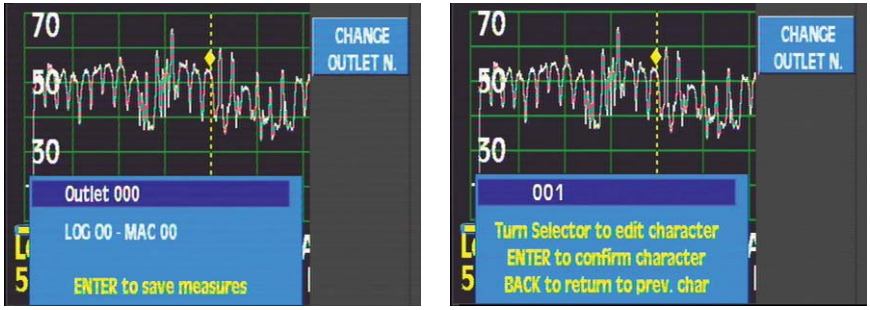


Figure 28.- Editing Outlet name

After naming the outlet, it can be saved by pressing the Enter button.

To execute the Macromeasurement again in a new outlet, press Enter again. If you want to finish the Macromeasurement, press any button.

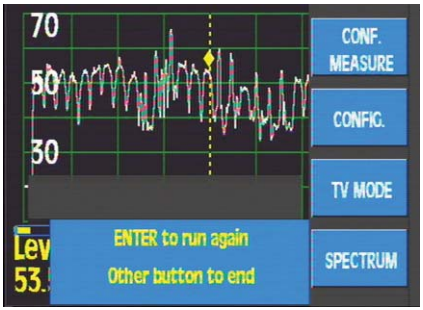


Figure 29.- Continue or cancel Macromeasurement

- LOG options. This option lets us select the possibility of continuing with a LOG which we had previously created or of starting with a new one, in this case the equipment will suggest a name for the new "LOG" register and will also suggest a two-digit number which will be the lowest available.

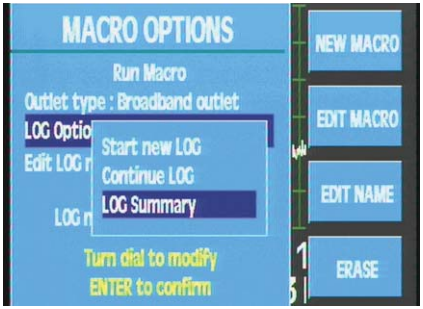


Figure 30.- LOG options

- LOG Summary. After executing a Macromeasurement, the **FSM 650** processes the information obtained to **automatically carry out an evaluation of the signal quality** present at the socket.

To do this, the measurements obtained are compared with the minimum and maximum desirable values for each socket.

On ending the Macromeasurement, if all the measurements obtained fall

within these limits, a screen will appear showing the number of measurements performed and bearing the message “all measurements correct”.

In the event that the measurements fall outside the preset limits, the user will be shown the information on such measurements (value of the measurement and channel information). Thus the installer can concentrate on the problem channels, performing the actions required for installation.

Figure 31.- LOG Summary

Signal thresholds that have been used are shown in Appendix 3.

- Edit LOG name. This function lets the user modify the name of the new LOG.

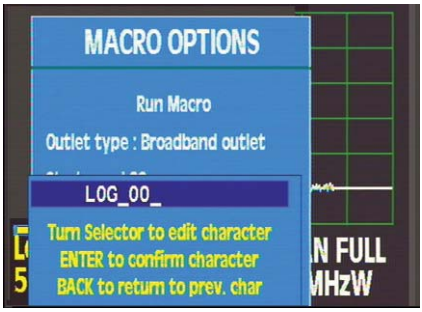


Figure 32.- Editing the LOG name

Note: *If we are executing a Macromeasurement, the function "Automatic shut-down" will be postponed until the end of this process.*

3.3.1.4.2.1.- New Macro

This option lets us create new Macromeasurements using the memories inside the meter.

A window opens and the name of a Macromeasurement appears with the cursor flashing. The name that the equipment proposes to identify each Macromeasurement is: “MAC” and a two-digit number which will be the lowest number available at that time. Using the function “3.3.1.4.2.3.- Edit Name” we can name the Macromeasurement as we like, so as to identify it more easily.

The **maximum number** of Macromeasurements that can be stored in the meter is **100**, if the user tries to save a new Macromeasurement, the message "*MACROS FULL*" will appear onscreen.

Figure 33.- Create new Macromeasurements

Press Enter to confirm, and then a list of the available memories appears.

Figure 34.- Editing a Macro

We can use the rotating knob to move through the list. When we find the memory we are going to use, we should press Enter and the memory will be highlighted.

If we want to select all the meter’s memories, we can use the **SELECT ALL** option, so that all the memories are hightlighted.

Note: *When using the SELECT ALL option, if the number of measurements is higher tan 250, the meter will show a warning on the screen and only select the first 250. This warning message will also appear when we are selecting the memories manually..*

The meter does not allow you to make macromeasurements based on WI-FI memories, meaning that memories of this type cannot be selected for inclusion in the macromeasurement..

The ECOS memories of COFDFM will measure BER/MER. The DVB-S2 memories will store Link margin/MER measurements.

At the bottom of the window, we will be able to see some important information about each memory that has been selected and the number of memories that we are putting into the Macromeasurement.

When we have finished the selection process, we must press **CONFIRM** and then Enter. The message "*MACRO SAVED*" will appear onscreen.

The **maximum number of measurements** that can be executed by macromeasurement is **250.**

Depending on its configuration, the meter will be able to record more than one measurement per memory (the number of measurements is greater than that of memories).

3.3.1.4.2.2.- Edit Macro

This option lets the user change the memories inside a Macromeasurement. It works in the same way as when creating a new Macromeasurement.

3.3.1.4.2.3.- Edit Name

This option lets you change the name of a Macromeasurement.

Once you have confirmed the change of name the message "*NAME CHANGED*" will appear onscreen.

3.3.1.4.2.4.- Erase Macro

We can erase a Macromeasurement when we think it is necessary using this option. It works in the same way as then erasing a memory.

Once the macro has been erased, the meter will inform you via the message "*MACRO ERASED*".

3.3.1.4.3.- View DATA LOGS

In this section you can see the results of the Macromeasurements that were executed and the results of the SCAN&LOG.

The meter will display a window with a list of the DATA LOGS. At the bottom of the window you will see the content of each one.

The DATA LOGS are the measurements that the meter has saved when it has carried out any of the following functions: Macromeasurement or SCAN&LOG.

The measurements of a MACROMEASUREMENT can be identified because they consist of two columns; the first identifies the name of the log with which it has been saved and the second column indicates the name of the macromeasurement.

The measurements of a SCAN&LOG consist of a single column with the descriptive name that was assigned before it was executed.

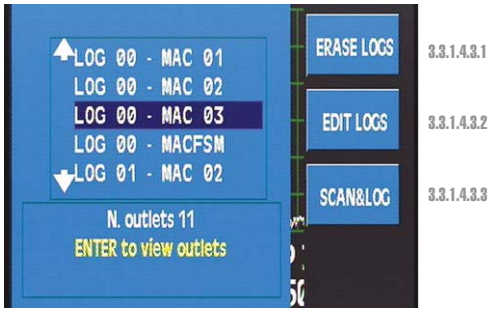


Figure 35.- List of DATA LOGS

If there aren't any DATALOGS stored in the meter's memory, the message "*NO DATALOGS*" will appear onscreen.

By pressing Enter a table with two columns will appear. On the left there are the outlets that have been measured and on the right there are the results of each outlet.

By turning the rotating knob, we can move through the different sockets of the LOG (left-hand column) and by pressing Enter we go to the column with the measurements of the socket that is highlighted (right-hand column). We can move through the different measurements of the socket in this column using the rotating knob. By pressing Back or Enter we return to the socket column.

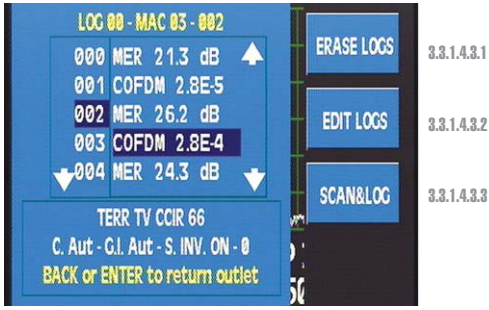


Figure 36.- Measurements in each outlet

3.3.1.4.3.1.- Erase LOGS

This option lets you erase the selected LOGS. To do this, use the rotating knob to mark the LOGS, selecting them using Enter. The marked registers will appear in yellow, then press the A button (CONFIRM) and complete the erasing process by pressing Enter. The message "*DATALOG ERASED*" will appear onscreen.

Note: *When you erase or edit a memory, it is also being erased or edited in the Macromeasurements where it appears. Erasing or editing a Macromeasurement does not affect the LOGs that have been generated with the erased or edited Macromeasurement.*

3.3.1.4.3.2.- Edit LOGS

This option lets us change the name of the desired LOG at any time. To do so, use the rotating knob to select the LOG, confirm your selection by pressing the Enter key. The name of this LOG will flash on and off and using the rotating knob and Enter button, we can change the characters.

3.3.1.4.3.3.- SCAN&LOG

The function SCAN&LOG added into the meter allows the equipment to automatically scan the terrestrial band and carry out the measurements depending on some selectable parameters.

This function can automatically identify if a channel is analogue or digital and store the measurements that characterise these channels in a "LOG".

Using this function, your **FSM 650** will carry out a scan of the whole terrestrial spectrum and will automatically identify the channels with levels that are higher than those indicated by the user.

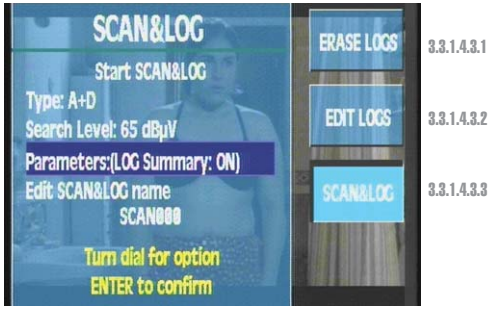


Figure 37.- SCAN&LOG function

When a SCAN&LOG is executed, the channel search level should be adjusted to the user preferences. The search level should be adjusted to between 40 and 120 dBµV.

The equipment is able to differentiate between analogue and digital channels and so in this way, the user can choose which type of SCAN to carry out:

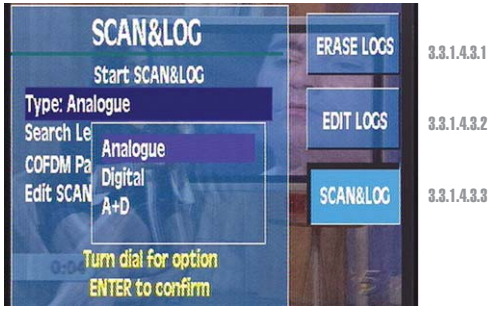


Figure 38.- SCAN type selection

-**Analogue**: the measurements will only be carried out in the analogue channels. The measurements are: Level, C/N and V/A.

-**Digital**: this only identifies the COFDM digital channels and carries out the power, C/N, BER and MER.

-**Analogue + Digital**: this identifies both the analogue channels as well as the COFDM digital channels and it will carry out the corresponding measurements. If it is a analogue channel, it will measure the level, C/N and V/A. If it is a COFDM digital channel, it will measure the power, C/N, BER and MER.

When the SCAN is for the digital channels, the user will also be able to select the parameters of the desired COFDM signal, or else leave them all on AUTO so that the meter can detect them automatically.

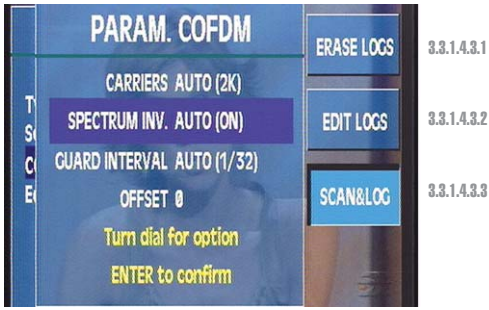


Figure 39.- Parameters selection

Note: It is advisable that if you know all or any of the parameters of the COFDM signal, do not leave them on Auto, since this increases the sweep time as the meter must try all the possible values of all the parameters.

The **LOG Summary** parameter is similar in operation to the Macromeasurements (See paragraph 3.3.1.4.2).

After executing a SCAN&LOG, the **FSM 650** processes the information obtained to **automatically carry out an evaluation of the signal quality** present at the socket. To do this, the measurements obtained are compared with the minimum and maximum potentially desirable values for each point.

On ending the SCAN&LOG, if all of the measurements obtained fall within these limits, a screen will appear showing the number of measurements performed and bearing the message “all measurements correct”.

In the event that the measurements fall outside the preset limits, the user will be shown the information on such measurements (value of the measurement and channel information). Thus the installer can concentrate on the problem channels, performing the actions required for installation.

The signal thresholds that have been used are shown in Appendix 3.

The SCAN&LOG shall be carried out within the channel plan that is selected at that moment. If the user wants to carry out a SCAN&LOG in another channel plan, it will be necessary to change it in the equipment's measurements configuration.

The equipment proposes a name for the SCAN&LOG automatically. This name can be changed so as to adapt it to the user preferences.

When the SCAN&LOG has finished, the user will be able to see the results in the meter and download them onto the PC using the FSM Management programme, which can process and create reports.

3.3.1.4.4.- Graphs

Function dealing with the graphs in the meter. This function will be available when the meter is in analyser mode. If you try to access this function in another mode, the message "ONLY SPECTRUM" will appear.

The meter lets you register up to **100 simple graphs** or **50 graphs** with maximums.

If the maximum function is enabled, both lines will be saved.

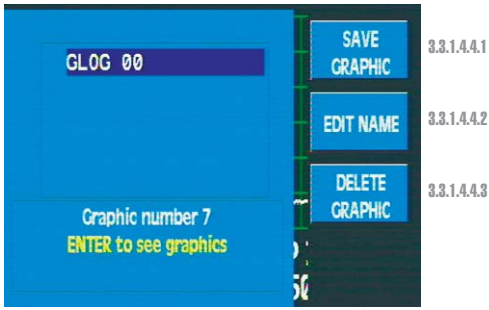


Figure 40.- GLOGs list

In this case of not having any graph saved, the meter will display the onscreen message "NO GRAPHS".

In order to see the graphs we will use the rotating knob through the GLOGs list and once we have found the desired one, we should pres Enter and the list of graphs that it contains will appear. We can select the graph and press Enter to retrieve it.

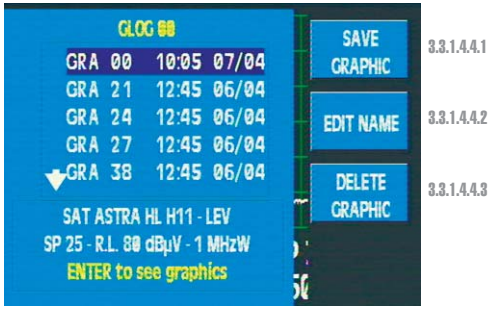


Figure 41.- List of graphs of a GLOG

While we are reviewing the graphs, a flashing message will appear onscreen which displays the name of the GLOG and the graph. Using the rotating knob, we can scroll through the graphs in the GLOG.

To exit viewing mode, press Enter or Clear Menu.

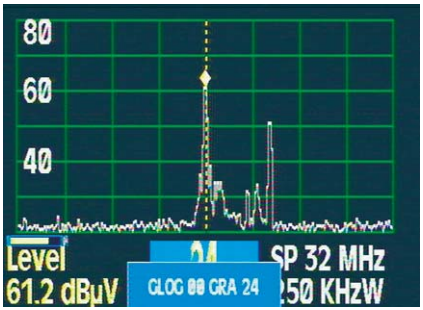


Figure 42.- A stored graph

3.3.1.4.4.1.- Save graphs

This option lets you save the graph that is being shown on the meter.

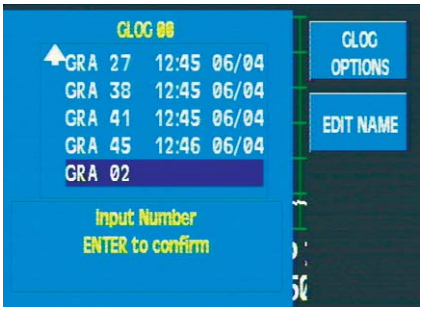


Figure 43.- Save a graph

We can put the graphs together into groups called **GLOGS**. The name of the first group of graphs suggested by the meter will be **GLOG00**.

In Analyser mode, we can easily save a graph using the short cut button 6 Rec / Plot.

3.3.1.4.4.1.1.- GLOG options

These functions let the user modify the location of the new graphs in the new GLOGS, in previously-created GLOGS or modify the name of the current GLOG.

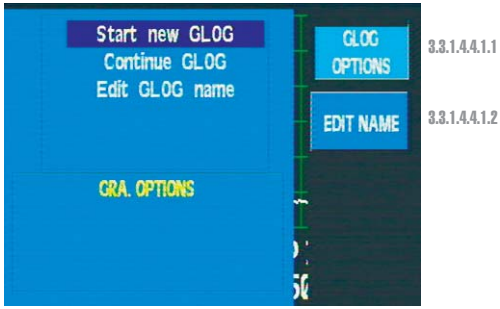


Figure 44.- GLOG options

3.3.1.4.4.1.2.- Edit Name

This option lets the user modify the name of the graph before saving it.

3.3.1.4.4.2.- Edit Name

This lets you change the name of the selected GLOG.

3.3.1.4.4.2.1.- Edit Graph Name

This option displays a list of the current GLOG's graphs. To change the name, select the graph and then press Enter.

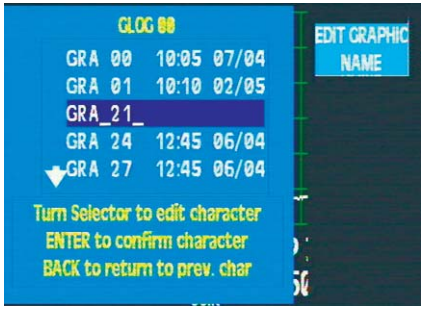


Figure 45.- Editing the name of a graph

3.3.1.4.4.3.- Erase Graph

With this function you can erase the GLOGS directly together with all the graphs they contain.

It is possible to select 1 or more GLOGs for the erasing process and then press Enter to confirm.

3.3.1.4.4.3.1.- Select Graphs

This option lets you erase the graphs in the selected GLOG. To do so, the graphs are selected using the rotating knob and by pressing Enter. When we have finished, we must press Confirm.

3.3.2.- Equipment configuration

The functions in this menu set all of the parameters that are related to the meter's configuration.

All of the windows that open in the different functions in the "Equipment Configuration" menu can be closed by using the **Clear** button.

Within this option, there is also the following submenu (if we press the arrow below, the following options will appear, as can be seen in the second picture):

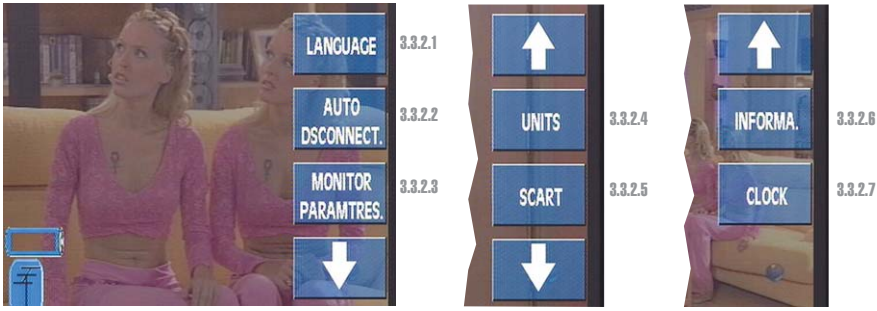


Figure 46.- Equipment configuration options

3.3.2.1.- Language

The **FSM 650** allows you to select the menu language. The languages that are available are: Spanish, English, Portuguese, French, German and Italian. The window that appears when this menu is selected looks as follows:

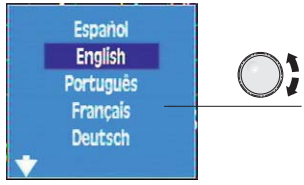


Figure 47.- Language selection for the menus

3.3.2.2.- Automatic shut-down

The equipment has the option of automatically turning off once a certain programmable time of inactivity has elapsed. This period of inactivity that can be selected ranges from 1 to 59 minutes. The user can also disable this function (OFF). The equipment has a default value for this period of inactivity of 15 minutes.

Figure 48.- Time left until shut-down

When the time programmed by the user has elapsed and the equipment has not been used, a message will appear onscreen "**Auto dsconnect**", together with an audio signal which will indicate that the equipment is about to shut-down. If no button is pressed, the message will appear 6 times and then the equipment will shut down.

Note: *Once the time that has been programmed by the user has passed, if a Macromeasurement is being carried out, the meter will wait until the end of this process before continuing with the disconnection.*

3.3.2.3.- Monitor

This menu consists of the functions that control the monitor's parameters: the volume, brightness, contrast and saturation. The window that appears when these functions are enabled is very similar in all cases. It consists of a horizontal bar. The length of this bar varies according to the level of the parameter that is selected. To change the value of these parameters, use the rotating knob and to close the windows use the **Clear** button.

Figure 49.- Monitor options

3.3.2.3.1.- Volume (short cut button 2)

Use the rotating knob to increase or decrease the volume. The volume screen appears as follows:

Figure 50.- Selection of volume

3.3.2.3.2.- Brightness (short cut button 2)

This increases or decreases the brightness of the picture onscreen. It operates in the same way as the volume control.

3.3.2.3.3.- Contrast (short cut button 2)

This increases or decreases the contrast of the picture onscreen. It operates in the same way as the volume control.

3.3.2.3.4.- Color (short cut button 2)

This increases or decreases the color of the picture onscreen. It operates in the same way as the volume control.

3.3.2.4.- Units

The meter includes the possibility of using several types of units: **dBµV**, **dBmV**, **dBµV/m** and **dBm**. The meter is configured by default to measure in dBµV.

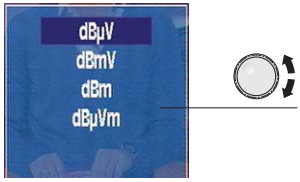


Figure 51.- Selection of units

dBµV: Used for devices with reduced output voltage, below 130 dBµV, such as antenna devices.

dBmV: Used for devices with reduced output voltage, particularly to provide input sensitivity data for receivers and in CATV equipment.

dBm: Used for high-power devices, such as transposers and transmitters.

dBµV/m: This unit corresponds to a measurement of the strength of an electric field at a given point. In order to take this measurement, it is important to take into account all of the elements present, from the system used for capturing the signal (an antenna), to the measurement equipment (previous elements, cable, etc.).

In the case of the FSM 650 range, this unit is calculated for a Televés DAT 45 antenna and 10 metres of T100 cable (for more information, visit the website http://www.televes.com).

The **ICT** standard defines a series of minimum levels that must be present at the point where the signal is taken. In the case of terrestrial TV, these are shown in next table:

Signal type	Frequencies (MHz)	Field strength
Analogue	470 - 582	65 dB(µV/m)
Analogue	582 - 830	70 dB(µV/m)
Digital	470 - 862	56.4 - 61.7dB(µV/m) 3+20 log f (MHz) dB(µV/m)

One application of this unit is to calculate the coverage diagram for a re-transmitting station, simply by situating the measurement system (antenna + cable + FSM) in different points of the geographic area being analysed, and calculating the geographic position of this measurement (using a GPS system).

Note: *The dBµV/m unit is only for the UHF band in* ***television*** *mode. When this unit is selected the meter will be automatically positioned within this band. If we change band or to spectrum, the meter will change to the unit that was being used beforehand.*

If we have the dbµV/m measurement unit selected, the meter will only use the UHF band (470MHz-862MHz).

3.3.2.5.- Scart

A window opens that allows you to select the control of the signals of the SCART:

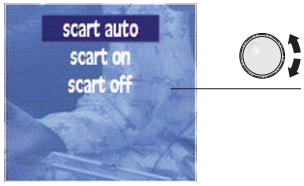


Figure 52.- Scart options

Scart auto: Normal operating mode of the scart, in other words, when there is a signal in the scart, it is automatically seen onscreen. It is important to note, however, that this function depends on the device being used, and therefore, it may be that, although a device with a video signal is connected to the scart, this may not appear onscreen. In this case, select the *Scart on* option. When the equipment is in *Scart auto* mode, and this detects a video signal in the scart, the antenna icon disappears from the screen (terrestrial or satellite) and instead, a television icon will appear: . The user therefore knows that the picture onscreen comes from the scart and not from the antenna.

Scart on: This forces the signal input from the scart connector. In this case, the television icon will always appear instead of the antennas, both when there is a signal from the scart and when there isn't.

Scart off: This disables the scart.

To close the window press the **Clear** button.

Notes:

- It is important to check the status of the scart mode selection, as if it is in *Scart on* mode, we will not be able to see the TV signal onscreen when we want to use the equipment in normal mode (input signal in the RF connector).
- If there is a signal in the scart, and if this is being seen onscreen (*auto* or *on*), the meter will carry on functioning normally as regards the measurements. In other words, the measurements that are carried out will correspond to the signal at the input of the "F" connector. It is not possible to take measurements of the scart signal. The same will happen with the spectrum representation of the signal, in other words, although the picture that we have onscreen will come from the scart, the spectrum will correspond to the RF input signal. **The only exception is the representation of the synchronism burst; this will indeed correspond to the synchronism of the scart's signal.**
- If the meter has a digital measurement window open (Power or C/N) it will be impossible to see the scart signal, although this may be in *auto* mode. **Therefore, if you wish to see the scart signal, make sure that the meter is not carrying out a digital measurement.**
- If you wish to see any TV signal onscreen, it is worth remembering that you can remove all the menus from the screen by using the **Clear/Menu** button, and the measurement windows by using the button or by accessing the Viewing Mode menu.

3.3.2.6.- Information about the equipment

When this function is selected, a window will open which will display information about the equipment, as can be seen below:

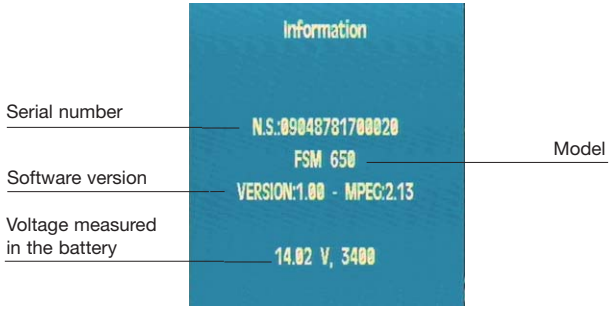


Figure 53.- Window displaying equipment information

3.3.2.6.1- Update

Using this option we can load the licence number in order to activate an options packet.

3.3.2.6.2.- Changing the battery

The **FSM 650** offers two possibilities when changing the battery:

A) A possibility is to change the battery for another with a different capacity. The equipment comes with a Ni-MH 6 AH battery which will provide the equipment with more than 4 hours of battery life.

When the installer wishes to change the batteries, it is necessary to inform the equipment so that it can modify the charging and discharging algorithm so as to optimize their lifespan and duration while in use.

Below is the process that must be followed when substituting the batteries:

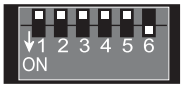
1.- Substitute the battery by following the steps described in section 5.1.- Changing the battery.

2.- Select the **Changing the battery** function. Select the appropriate option (either Ni-MH 3,5 AH or Ni-MH 6 AH). A message will appear onscreen asking for confirmation of the change. To confirm the change, press the button. If any other button is pressed, the change will be cancelled.

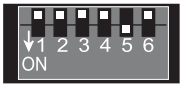
Figure 54.- Information window for changing the battery

Note: *This function must only be used when a battery change has really taken place, as it affects a series of parameters that are necessary for the control of the charging and usage of the batteries. If these vary, they will decrease the lifespan and the duration of the batteries. It is vitally important, in this model, to indicate the type of battery that is being introduced, as well as to check that it coincides with the selected type in the side microswitches (see figure "Configuration of the switches according to the type of battery").*

3.- Change the position of the battery's configuration microswitches. At first the microswitch P5 is above, and P6 below, and it is necessary to change the position of these microswitches, in other words, P5 should be below and P6 above. Below, is a diagram on how the microswitches should be placed according to the type of battery:



Standard battery Ni-MH 3,5 AH



Long life battery Ni-MH 6 AH

Figure 55.- Configuration of the switches according to the type of battery

4.- Switch the equipment off

5.- Disconnect the equipment from the mains

B) Another possibility is to substitute the battery for **another with the same characteristics**. In this case, you only need to carry out steps 1 and 2 as described in the previous section.

Warning about battery changing

- When removing or introducing the batteries, make sure that the meter is switched off.
- If you remove the battery, when you put it back in again, make sure that it is connected correctly.
- If you are using metal tools for the installation of the batteries, you must isolate them, as they could cause a shortcircuit.
- Do not connect the positive terminal to the negative terminal of a battery with a metal object, the battery could re-heat, emit hydrogen gas, undergo spillage, burn or explode.
- The user should use batteries provided by Televés, which are appropriate for this equipment.

3.3.2.6.3.- Battery regeneration

The **FSM 650** disposes of a function which carries out a recycling of the batteries. This option regenerates the batteries when the duration of the batteries has dropped considerably.

This process should only be carried out if the powering without supply from the mains has been reduced drastically since a repeated use of this function can shorten the battery life.

For the regenerating process to take place, it is necessary to externally power the meter continuously for 15 hours.

To start this process, the user must be inside this menu and then press

. Another screen appears which explains the process and by pressing

again, the process begins. If any

other key is pressed, the meter returns to its previous state.

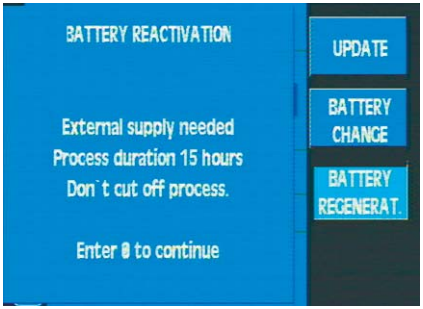


Figure 56.- Battery regeneration

When the charging process begins, the meter will switch off while the battery light and the ON light will flash on and off.

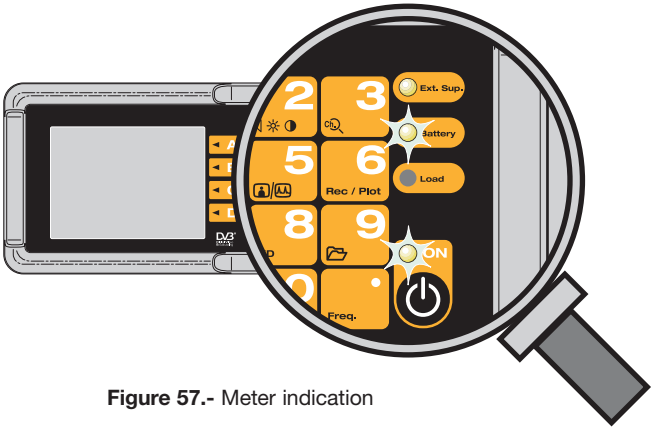


Figure 57.- Meter indication

Once this process has finished, the ON light will switch off and the battery light will switch on.

If, after this process, it is not possible to see an increase in the battery life, it is advisable to change the batteries.

3.3.2.7.- Clock

The window that appears as follows:

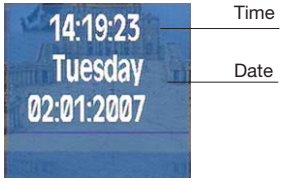


Figure 58.- Clock option

It is possible to vary the time (the hour and minutes) and the date (day, month and year). To do so, the user needs to press the rotating knob and the hour (in the time) will appear highlighted (dark blue square). If the user turns the knob the time will vary. When the knob is pressed again, the hour is confirmed and the minutes are hightlighted. If the knob is pressed for the third time, the day is highlighted, then the month and finally the year. The name of the day will vary automatically according to the corresponding month and year.

To close the clock window press the **Clear** button.

3.3.3.- TV mode (short cut button 5)

When this menu is selected, the equipment switches automatically to TV mode, in other words, the user will see the demodulated television signal of the tuned channel onscreen.

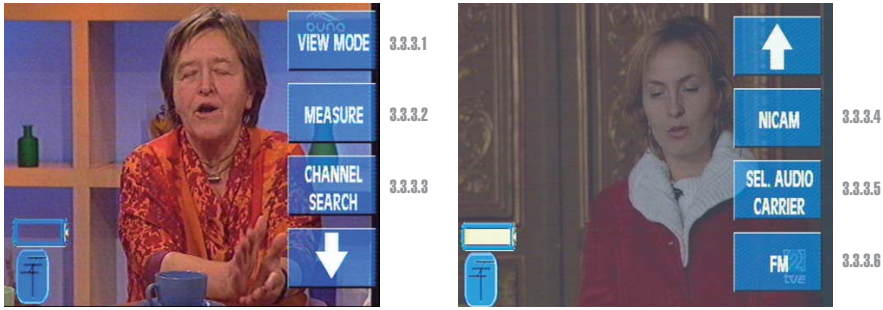


Figure 59.- TV mode options

The corresponding submenu is the following:

3.3.3.1.- Viewing mode

The functions of this menu let you choose the elements that you wish to see on the screen of the meter; the bar indicating the level, the representation of the synchronism burst and the measurement window.

3.3.3.1.1. Bar

On the upper part of the screen, there is a horizontal bar which indicates the signal level of the tuned frequency in green (if it is in frequency tuning) or the video carrier level (if it is in channel tuning). As well as the signal level, other additional information may appear; if a V/A measurement is being carried out, a red bar will appear on top of the green bar which indicates the audio carrier level, and if the C/N is being measured, the noise level that is measured will appear in red. This is explained in greater detail in the corresponding sections.

If this option is pressed again, the bar disappears.

Figure 60.- Indication via bars

3.3.3.1.2.- Synchronism

This option displays the representation of the synchronism burst on the left-hand side of the screen.

If a digital measurement is being carried out (power, C/N, BER, MPEG), it will not be possible to see the synchronism burst, as the meter supposes that the tuned channel is digital and therefore does not represent this burst.

If this option is pressed again, the synchronism burst disappears.

Figure 61.- Synchronism indication

As you can see, the backgrounds of the level bar and the synchronism burst are transparent so that they do not interfere with the image onscreen.

3.3.3.1.3.- Measurements window (short cut button 4)

When this option is selected, the window that corresponds to the last measurement that was carried out, opens. In other words, if the last measurement that was carried out was the C/N (for example), the C/N window will open and the C/N measurement will be carried out in the tuned channel.

As was the case before, to close the window, you simply need to select the same option again.

However, if the level measurement appears, there are two different windows that represent this measurement: the abbreviated and the extended windows. The first of these displays the tuned frequency (or channel) and the measurement. The extended window displays this information too, but also displays some information on the audio carrier, the colour standard, the channel plan, the resolution filter, the current that is being supplied to the preamplifiers and if the 22 MHz tone is enabled.

The first time that this option is pressed, the abbreviated window appears, if this option is pressed again, the extended window appears, and if it is pressed again, this option closes.

These windows will be explained in greater detail in the *Measurements-Level* section.

It is also necessary to note that the short cut button is not operative when a digital measurement is selected, in other words, once a digital measurement window is opened, it will not be possible to close it, the user will be able to substitute it for another, but there will always be a measurement window open. This is because as there is nothing onscreen about the TV signal, it is not necessary to close all the windows, as the screen would turn black and this could cause confusion.

Below, you can see an example of the screen with all of these elements on display:

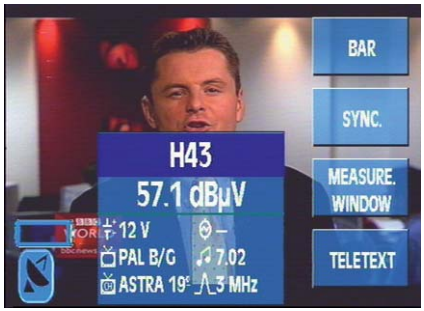


Figure 62.- Extended window

3.3.3.1.4.- Teletext

When this function is selected, the teletext information of the tuned channel will appear onscreen (if the channel does not dispose of this information, NO TTX will appear). The representation level of the teletext function is 1.5

Figure 63.- Teletext window

We can travel through the teletext pages using the rotating knob. We can access a teletext page by pressing **Freq.** and then entering the page number. To return to the picture from the TV signal, you need to press the Teletext button again.

3.3.3.2.- Measurements

When we select a specific measurement, a window will open which will display the measurement just carried out and the frequency (or channel) of the measurement, which corresponds to the frequency (or channel) that the user has tuned.

It is possible to vary the tuned frequency as you watch the measurement window. In this way, we can carry out the same measurement in consecutive frequencies (or channels) very simply. To vary the frequency, use the rotating knob or the number pad. To enter the frequency with the keyboard, press the **Freq.** button until the frequency information that appears in the window is erased. Now you will be able to enter the frequency using the keyboard. It is important to remember at this point that to insert the dot that separates the decimals, you also need to use the **Freq.** button.

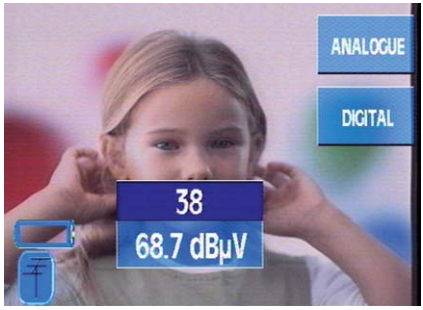


Figure 64.- Measurement menu

3.3.3.2.1.- Analogue measurements (short cut button 8 A/D)

The corresponding submenu is as follows:

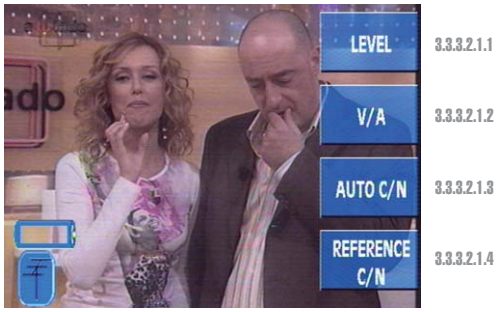


Figure 65.- Analogue measurements

3.3.3.2.1.1.- Level

If the channel tuning mode has been selected, this function will measure the carrier level of the tuned channel. If, however, the frequency tuning mode has been selected, the signal level of the tuned frequency will appear in the window.

As we have already seen in the *Viewing mode - Measurements* section, there are two possible windows for the level measurement (abbreviated and extended). Below you can see an example of a level measurement window in its abbreviated form:

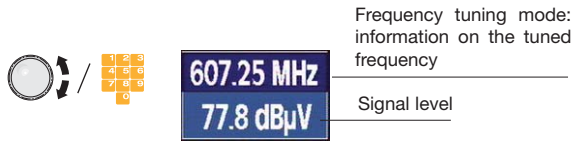


Figure 66.- Abbreviated form

You can vary the frequency by using the rotating knob (in the terrestrial band with a resolution of 50 KHz and in the satellite band 100 KHz), or by using the number pad.

In the extended window, the following information appears:

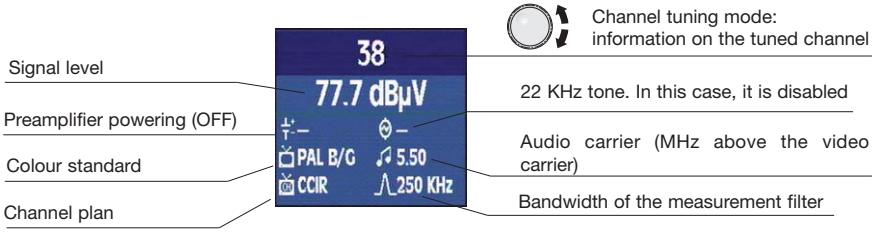


Figure 67.- Extended form

When in *Viewing - Measurements mode*, if the extended window is selected for the level measurement then this will always be used when carrying out this measurement, until we change the viewing mode.

3.3.3.2.1.2.- V/A (only the terrestrial band)

The window that appears when carrying out this measurement is the following:

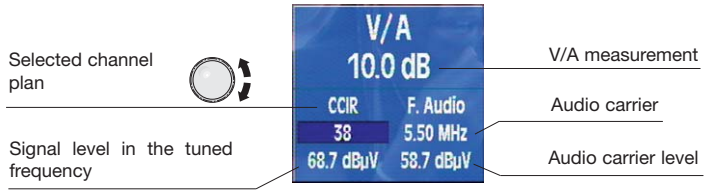


Figure 68.- V/A measurement. Channel tuning

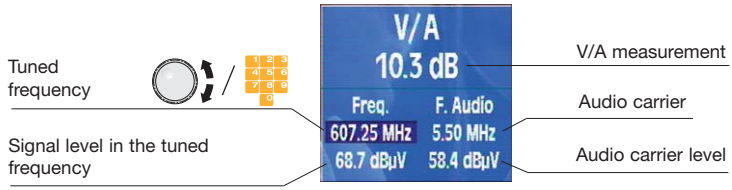


Figure 69.- V/A measurement. Frequency tuning

The tuned frequency is taken as the video carrier, in other words, it is where the video level is measured. The audio carrier level is taken to be as many MHz higher as indicated in the Audio information that appears onscreen (5.50 in the example). By pressing the **Freq.** button, the information on the tuned frequency is highlighted. Once this has been done, we can vary the tuning by using the rotating knob or the number pad.

If we press the **Chan.** button, the information on the tuned channel will appear. The frequency that is used to carry out the video level measurement will be the video carrier of the channel that the equipment searches for automatically.

Therefore, when the equipment is in frequency tuning mode, it is the user's responsibility to make sure that the tuned frequency is really the video carrier of the channel that the V/A measurement is to be carried out on, in order for the measurement to be totally correct.

If the level bar is visible when the V/A measurement is being carried out (see section *3.3.3.1.1.- Bar*), two overlapping bars will appear, one in green which indicates the video carrier level (channel tuning) or the tuned frequency level (frequency tuning), and the other in red which indicates the audio carrier level.

Figure 70.- Indication of V/A using the bars

3.3.3.2.1.3.- Automatic C/N

When this function is selected, a window with the carrier / noise ratio will appear automatically onscreen. The window that appears is the following:

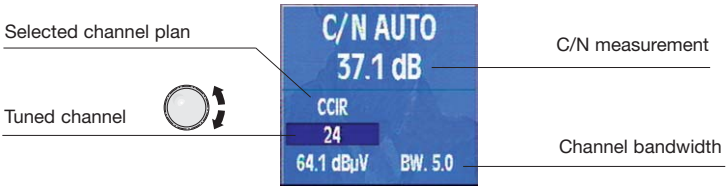


Figure 71.- Automatic C/N measurement. Channel tuning

Figure 72.- Automatic C/N measurement. Frequency tuning

If in channel tuning mode, you will be able to see the channel with the carrier that is being used to carry out the level measurement. As has already been explained in the section regarding the V/A ratio measurement, if the equipment is in frequency tuning mode, the level measurement will be carried out in the frequency that the user has tuned, and so it will be the user's responsibility to make sure that this frequency corresponds to the real channel carrier.

If the level bar is visible when the C/N measurement is being carried out (see section *3.3.3.1.1.- Bar*), two overlapping bars will appear, one in green which indicates the video carrier level (channel tuning) or the tuned frequency level (frequency tuning), and the other in red which indicates the measured noise level.

Figure 73.- Indication of C/N via bars

This function has the following submenu:

3.3.3.2.1.3.1.- Channel BW

When this option is pressed, a small window opens on top of the previous window, displaying the value of the video bandwidth which will be taken into account when automatically compensating the noise (we recommend 5 MHz for this measurement). As the user turns the rotating knob, the different options will appear. To select a value, press this knob.

3.3.3.2.1.4.- Referenced C/N

When this function is selected, the video signal automatically disappears from the screen. This is because the equipment has to carry out the noise measurement in the reference frequency. Because of this, the ***button is not enabled.***

The window that appears when this function is selected is the following:

Figure 74.- Referenced C/N measurement. Channel tuning

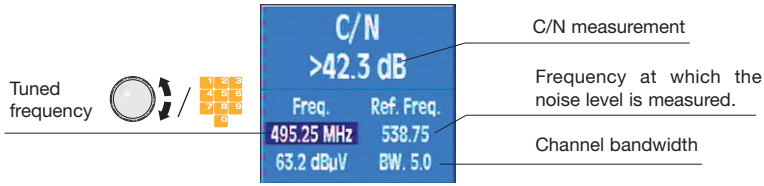


Figure 75.- Referenced C/N measurement. Frequency tuning

If in channel tuning mode, you will be able to see the channel with the carrier that is being used to carry out the level measurement. As has already been explained, if the equipment is in frequency tuning mode, the level measurement will be carried out in the frequency that the user has tuned, and so it will be the user's responsibility to make sure that this frequency corresponds to the real channel carrier.

To carry out this measurement, it is necessary to indicate two parameters; the **frequency** at

which you want to measure the noise level (reference frequency) and the **channel bandwidth**. To do so, this function has the following submenu:

3.3.3.2.1.4.1.- Reference frequency

By pressing this option, the noise frequency is highlighted in the window (dark background). You can vary the noise frequency by using the rotating knob. Once the reference frequency has been selected, if you press the **Freq.** button, the current frequency is erased and the you can enter the frequency that you want by using the number pad.

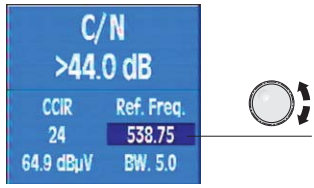


Figure 76.- Reference frequency

3.3.3.2.1.4.2.- Channel BW

When this option is pressed, a small window appears over the previous window which displays the video bandwidth that will be taken into account when automatically compensating for the noise (we recommend 5 MHz). When rotating knob is turned, the different options appear. To select the value that you want, simply press the rotating knob.

Figure 77.- Channel bandwidth

3.3.3.2.2.- Digital measurements (short cut button 8 A/D)

When a digital measurement is selected, the image from the TV signal will disappear from the screen, and a warning message will appear that indicates that this is a digital measurement.

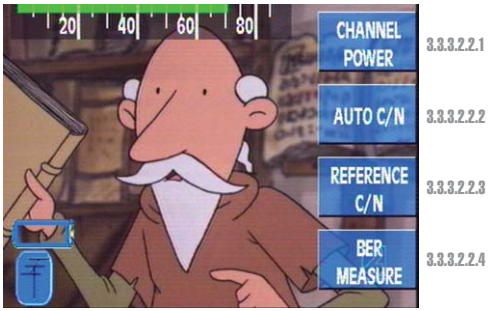


Figure 78.- Options for digital measurements

3.3.3.2.2.1.- Channel power

If the equipment is in TV mode, when this function is selected, the image from the TV signal will automatically disappear from the screen, and a warning message will appear that indicates that this is a digital measurement, as can be seen in the following figure.

If the frequency tuning mode is selected, the tuned frequency will be taken as the **intermediate frequency of the digital channel**. As in the measurements that have already been explained, the user can use the rotating knob or the number pad to vary the frequency (or the channel) in which the measurement is to be carried out. The power measurement will be carried out by using the bandwidth that was entered by the user and by using its value that appears in the measurement window.

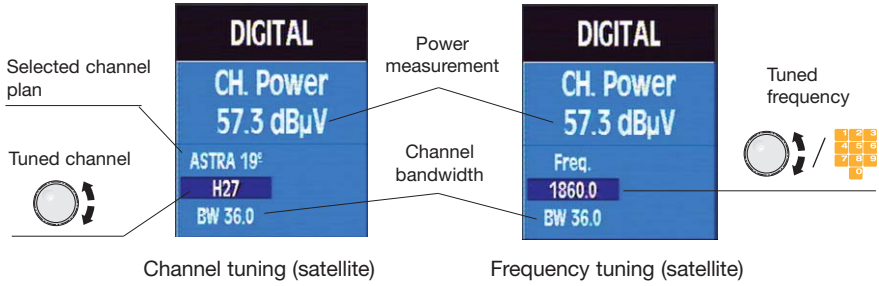


Figure 79.- Digital channel power

To change this parameter, the following submenu appears:

3.3.3.2.2.1.1.- Channel bandwidth

If this option is pressed, the value of the bandwidth is selected in the channel power window. You can change this value by using the rotating knob:

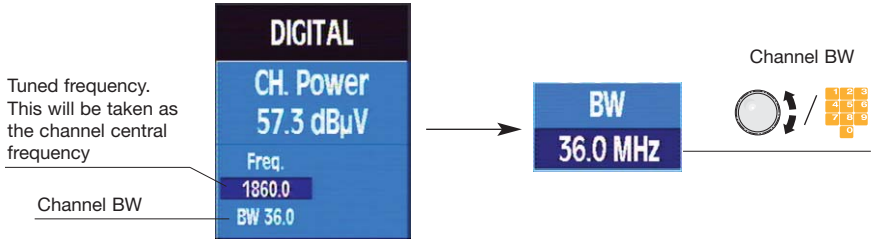


Figure 80.- Bandwidth

3.3.3.2.2.2.- Automatic C/N

This function is the same as the automatic C/N in the analogue channels. Above the window, it is possible to see that this is a digital measurement.

3.3.3.2.2.3.- Referenced C/N

This function is the same as the referenced C/N in the analogue channels. Above the window, it is possible to see that this is a digital measurement.

3.3.3.2.2.4.- BER measurement

The submenu of this function varies, depending on the band that is selected (either terrestrial or satellite).

When the BER is being measured, the Network Provider information, the Number of Services and the name of the Services will be displayed at the bottom of the window.

Terrestrial band Satellite band

Figure 81.- Options for the BER measurements

The window that opens when any of the modulations is selected is the same, however the type of modulation varies:

BER before Viterbi

While the meter is unlocked, the following message will appear: **UNLOCK**.
After a few seconds, the message will disappear and the BER measurement appears.

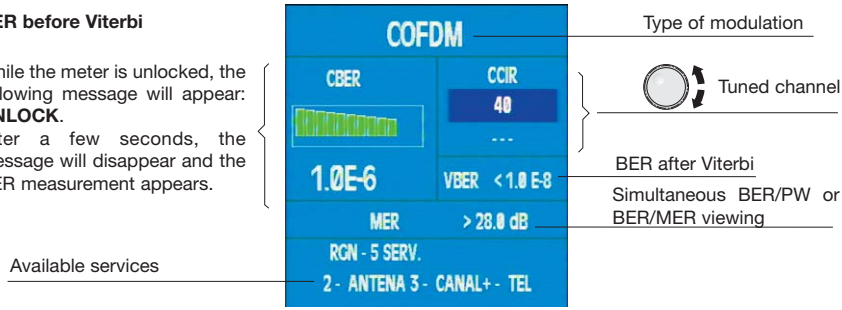


Figure 82.- BER measurement window

To indicate if the CBER measurement is at an acceptable threshold, the colour of the bars varies. When the CBER is red, this indicates that the signal quality is bad. When the CBER measurement is yellow, this indicates that the signal quality is acceptable but it would be better to improve it. If the CBER measurement is green, this indicates that the signal quality is good.

It is very important to take into account that the CBER parameter determines quite clearly the quality of the installation. This is why we have simplified the interpretation of this parameter with these colours. The VBER is a parameter that has practically only got two states, either very good or very bad, which makes it difficult to use to appropriately evaluate the installation. This is why we recommend using the CBER status to assess the quality of the installation (it should be a small as possible).

The meter enables the simultaneous viewing of BER/PW or BER/MER measurements.

Note: *The power measure in the simultaneous window BER/PW is estimated. For a precise measure, one must use the individual power measure of the analyser or of the TV mode.*

3.3.3.2.2.4.1.- COFDM (only terrestrial band)

Carry out the BER measurement of the digital terrestria signals with COFDM modulation. The submenu for this type of modulation is the following:

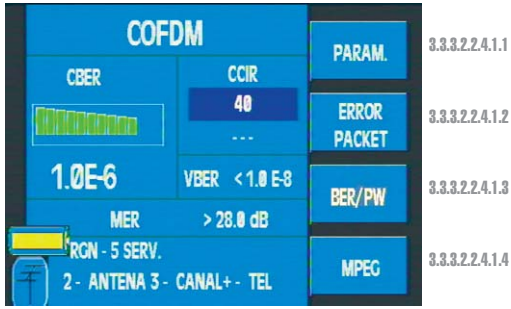


Figure 83.- COFDM measurements

The meter is able to identify DVB-H modulation. When the meter detects a channel with this modulation, a message will be shown at the upper right of the screen.

Figure 84.- Detection of DVB-H modulation

3.3.3.2.2.4.1.1.- Parameters

When this menu is selected, a window appears on top of the BER measurement window which displays a list of the parameters that can be selected. To vary a specific parameter, use the rotating knob (selecting and pressing), a window will appear with a list of all the possible values for this parameter. The parameters tha can vary in COFDM are: Number of carriers (**2K**, **8K**, **AUTO**), Spectrum Inversion (**ON**, **OFF**, **AUTO**), Guard Interval (**1/32**, **1/16**, **1/8**, **1/4**, **AUTO**), Offset (**0, 1/6**, **2/6**, **3/6**, **-1/6**, **-2/6**, **-3/6**, **AUTO**). When the AUTO option is selected in any of the parameters, the equipment automatically selects the appropriate option, although the locking time will increase.

Below is an example of a parameter selection window:

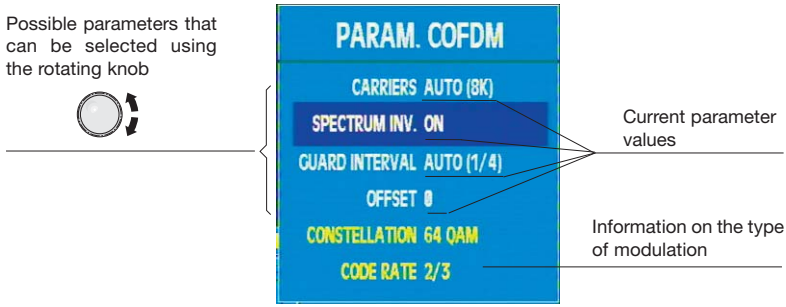


Figure 85.- COFDM parameters

When the rotating knob is pressed, the window that corresponds to the selected parameter opens:

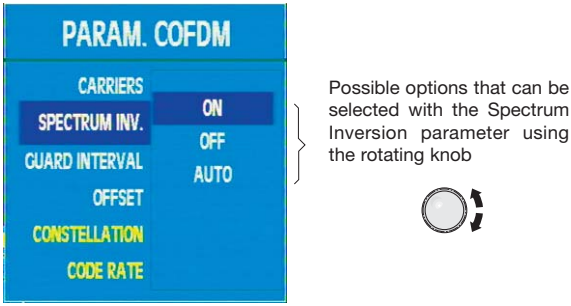


Figure 86.- COFDM parameter options

In the Offset option, if the COFDM channel has a frequency deviation, you can apply an offset (**0, 1/6, 2/6, 3/6, -1/6, -2/6, -3/6, Auto**) to correct this deviation.

This **will only be valid in channel mode** and you can select it by choosing the current COFDM channel.

The selection can be **manual** or **automatic**. When you select the automatic option, the equipment will automatically detect the offset. This may take a few moments as a scan is carried out for with all the possible offsets.

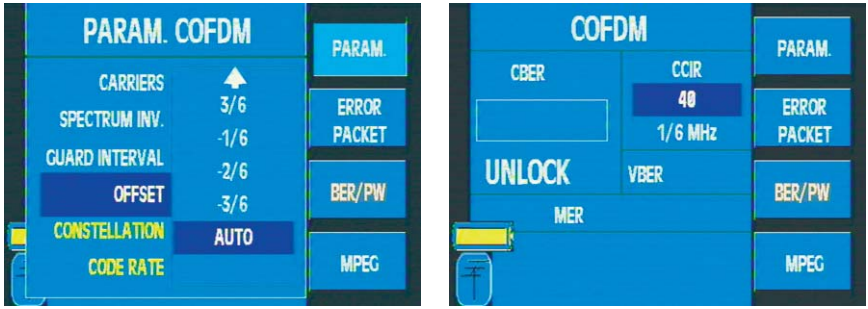


Figure 87.- Determining a COFDM offset

The parameter window will display the information on the constellation being used in each carrier and the code rate in yellow.

3.3.3.2.2.4.1.2.- Advanced measurements

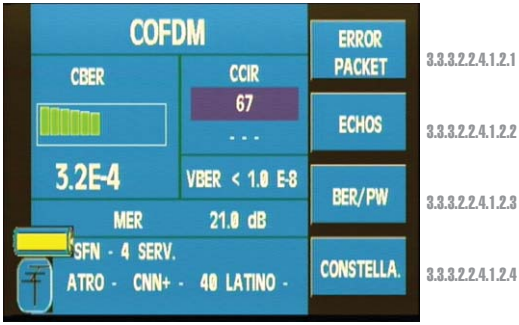


Figure 88.- Advanced measurements

3.3.3.2.2.4.1.2.1.- Error packets

When this function is selected, a window opens which displays the following information: the maximum number of error packets in a 10 minuted interval, the time that has elapsed since the last error and the time that the equipment has been locked onto the signal for (without a visible error on the screen). The window that displays this information is the following:

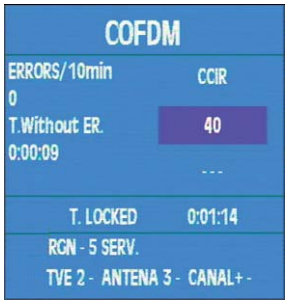


Figure 89.- Error packets

This function is very useful when identifying problems in an installation, which a certain measurement at a specific time has not been able to detect.

3.3.3.2.2.4.1.2.2.- Impulse Response (ECHO)

The **FSM 650** allows users to analyse the response from the COFDM channel and to detect possible problems in the signal quality caused by the reception of signals from different sources.

To access this function from COFDM, the button Advanced Measurements => Impulse Response must be pressed.

The channel response is shown in blue, the vertical scale shows the value of losses in (dB) with respect to the main echo of the different echoes, and the horizontal scale shows the separation of these echoes. This separation may be shown both in time units (µs) or in distance units (Km.)

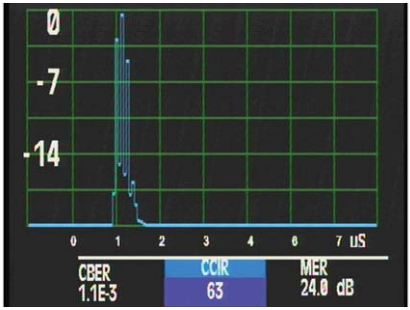


Figure 90.- Impulse

The CBER will also be shown, with 3 other values shown alternatively to the right: the MER measurement, an ECHO OUT measurement, representing the echo value outside of the guard interval, and the CELL ID, making it possible to identify the transmitter the signal we are receiving comes from.

3.3.3.2.2.4.1.2.2.1.- Param ECO

The parameters allow the units to be changed (Km, µs) and the maximum distance value we can visualise (4µS – 64µS).

The difference in amplitude with respect to the main echo that can be visualised will be a maximum of 20 dB.

3.3.3.2.2.4.1.2.3.- BER/PW

This function enables commuting between simultaneous BER/PW and BER/MER viewing.

3.3.3.2.2.4.1.2.4.- Constellation

This function represents the COFDM constellation of the selected carrier.

The COFDM transmission of any cannel is comprised of some 8000 carriers, of which 6817 are active, divided into signal carriers and data carriers.

The COFDM constellation screen shows the following information: STATUS, indicating if the signal is connected or not, and the carrier number.

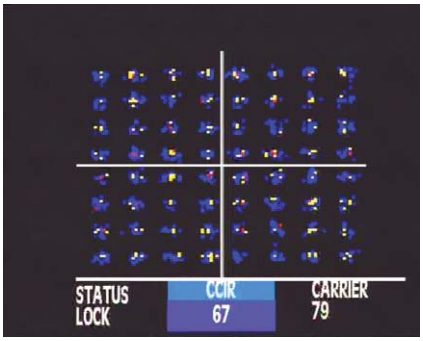


Figure 91.- Constellation

To change the selected carrier, the following submenu appears:

3.3.3.2.2.4.1.2.4.1.- Carrier

Clicking on this menu makes it possible to change the carrier selected in the COFDM constellation. This may be varied by using the dial or the numeric keyboard, first pressing the **Freq** key.

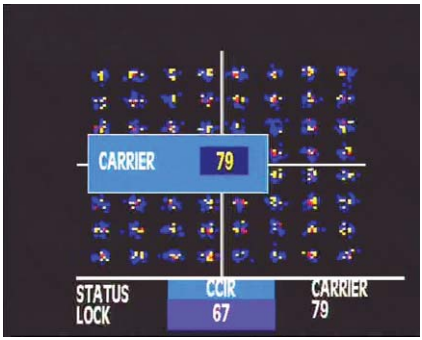


Figure 92.- Carrier

3.3.3.2.2.4.1.3.- BER/PW

This function enables commuting between simultaneous BER/PW and BER/MER viewing.

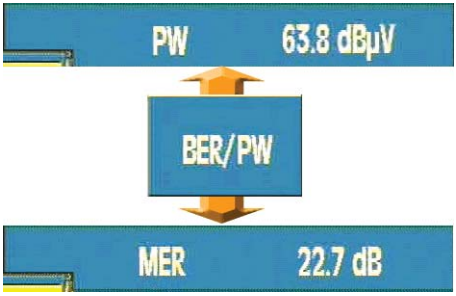


Figure 93.- Commuting between PW and MER

Note: *The power measure in the simultaneous window BER/PW is estimated. For a precise measure, one must use the individual power measure of the analyser or of the TV mode.*

3.3.3.2.2.4.1.4.- MPEG

By pressing on this option, the MPEG decoding is enabled. The message "*STARTING MPEG*" will appear and then the search for the available services will begin, with the message "*SEARCHING SERV*.".

If we do not dispose of a COFDM signal, the screen will display "*UNLOCK*".

By using the rotating knob we can access the list of channel services. When the desired channel has been found, press Enter to confirm the choice. Now it is necessary to select the desired audio.

Figure 94.- MPEG decoding of a COFDM channel

In this option there is an extended window (short cut 4) which displays some information about the tuned channel: the number of services, the selected service (if it is a scrambled channel, # will appear beside the name), the SID network identifier, VPID (for the audio channels the value 0 will appear) and the APID.

The Network Identifier (NID) is also shown (in the event that this value is unknown, the number will be shown in hexadecimal format), a high definition service is identified and information is shown on the type of MPEG (audio and video), video resolution and aspect.

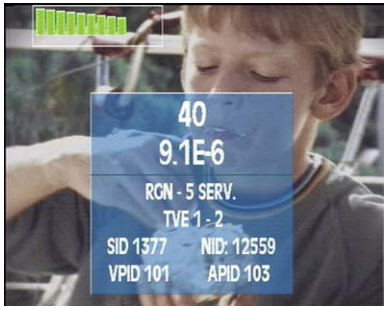


Figure 95.- Channel information

Note: *It is possible to change service at any moment by using the rotating knob.*

To change channnel press Chan. .

3.3.3.2.2.4.2.- QAM (only terrestrial band)

When this function is selected, the equipment measures the BER of a digital signal with QAM modulation. The information window is identical to the previous one. The submenu for this function is the following:

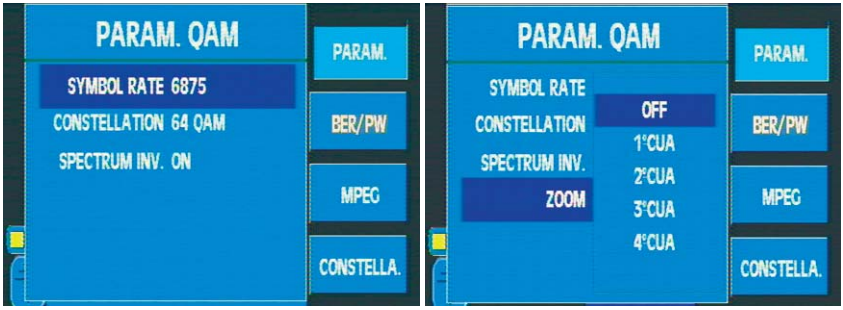
Figure 96.- QAM measurements

It is very important to take into account that the CBER parameter determines quite clearly the quality of the installation. This is why we have simplified the interpretation of this parameter with these colours. The VBER is a parameter that has practically only got two states, either very good or very bad, which makes it difficult to use to appropriately evaluate the installation. This is why we recommend using the CBER status to assess the quality of the installation (it should be a small as possible).

3.3.3.2.2.4.2.1.- Parameters

The parameters that can be selected for a QAM signal are: Symbol rate (**6875**, **6111**, **5156**, **4583**, **5893**, **5238**, **6900**, **OTHER (6875)**), Constellation (**4QAM**, **16QAM**, **32QAM**, **64QAM**, **128QAM**, **256QAM**, **OTHER**), and Spectrum Inversion (**ON**, **OFF**, **AUTO**). These parameters are selected in exactly the same way as those with COFDM modulation.

If we are in constellation mode, as well as the previous parameters, we will also dispose of the **ZOOM** parameter to select the square we want to see of the constellation.



BER parameters Constellation parameters

Figure 97.- Parameter options

3.3.3.2.2.4.2.2.- BER/PW

This function enables commuting between simultaneous BER/PW and BER/MER viewing.

Note: *The power measure in the simultaneous window BER/PW is estimated. For a precise measure, one must use the individual power measure of the analyser or of the TV mode.*

3.3.3.2.2.4.2.3.- MPEG

By enabling this option, the user enters the MPEG decoding mode in a QAM channel. The operation mode is similar to MPEG of COFDM (see 3.3.3.2.2.4.1.4).

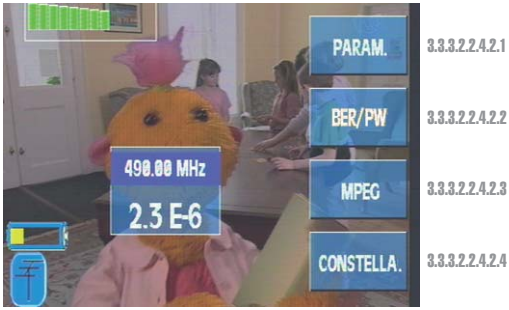
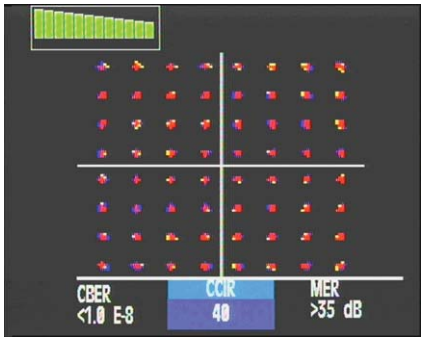


Figure 98.- MPEG decoding of a QAM channel

3.3.3.2.2.4.2.4.- Constellation

This function enables the representing of the QAM constellation. The screen will also show complementary information for evaluating CBER/MER signal quality or BER/PW depending on the simultaneously viewed measurement in the BER QAM window.

By accessing "PARAMETERS" we can amplify any of the quadrants.



Constellation image

Zoom 1º quadrant

Figure 99.- Representation of the QAM constellation

3.3.3.2.2.4.3.- QPSK (only the satellite band)

This function measures the BER of a digital signal with QPSK modulation. The information window is exactly the same as the window for the QAM and COFDM modulations. The submenu is the following:

Figure 100.- QPSK measurements

3.3.3.2.2.4.3.1.- Parameters

The parameters that can be selected for a QPSK signal are the following: Symbol Rate (**AUTO**, **27500**, **24500**, **22000**, **15000**, **OTHER**), Code (**Auto**, **2/3**, **3/4**, **5/6**, **7/8**, **1/2**), and Spectrum Inversion (**ON**, **OFF**, **AUTO**). The parameters are selected in the same way as with the previous functions.

We recommend using the **AUTO** mode for all parameters. The QPSK signal will connect almost instantly.

3.3.3.2.2.4.3.2.- Error packets

The window that opens when this function is selected and the information that is displayed is exactly the same as with the COFDM modulation.

This function is very useful when identifying problems in an installation, which a certain measurement at a specific time has not been able to detect.

3.3.3.2.2.4.3.3.- BER/PW

This function enables commuting between simultaneous BER/PW and BER/MER viewing.

It is very important to take into account that the CBER parameter determines quite clearly the quality of the installation. This is why we have simplified the interpretation of this parameter with these colours. The VBER is a parameter that has practically only got two states, either very good or very bad, which makes it difficult to use to appropriately evaluate the installation. This is why we recommend using the CBER status to assess the quality of the installation (it should be a small as possible).

Note: *The power measure in the simultaneous window BER/PW is estimated. For a precise measure, one must use the individual power measure of the analyser or of the TV mode.*

3.3.3.2.2.4.3.4.- MPEG

With this option, the MPEG mode of a QPSK channel is enabled. The functions in the same way as in QAM and COFDM.

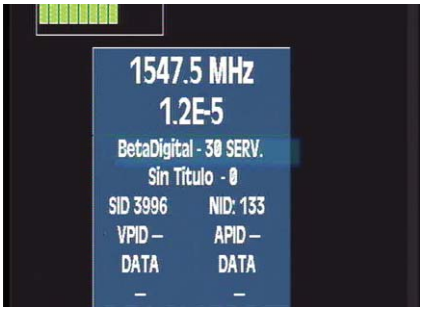


Figure 101.- Identification of a data service

3.3.3.2.2.4.4.- DVB-S2 (satellite band only)

This function allows us to obtain the quality measurements for a DVB-S2 signal.

The Link Margin (dB) is used to evaluate the quality of the signal, indicating how 'far' the signal is from the breakdown point. This means that the higher the Link Margin, the better the signal.

Three additional measurements are provided: CBER, MER and BCHBER (the bit error rate of the BCH error correction algorithm).

Once the multimeter connects the DVB-S2 signal, on the bottom of the screen it shows the transponder name, the number of services and the name of each service

.

Figure 102.- DVB-S2

3.3.3.2.2.4.4.1.- Parameters

The only parameter that has to be defined for measurements in DVB-S2 signals is the symbol rate. The multimeter has the most usual rates pre-defined: 27500, 24500, 22000 and 15000. However, the number pad may be used to enter any other value required.

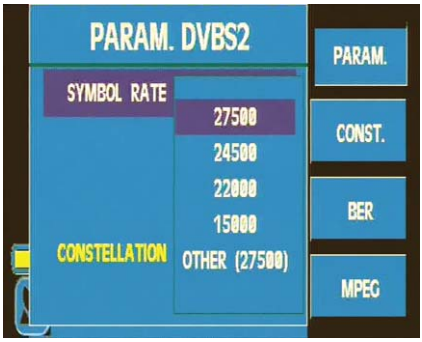


Figure 103.- Parameters

3.3.3.2.2.4.4.2.- Constellation

This function makes it possible to view the constellation of the DVB-S2 signal.

Figure 104.- Constellation

The multimeter will also show the Link Margin in the same window in numerical format and as a colour bar code, and the MER value (dB)).

3.3.3.2.2.4.4.3.- BER

By clicking on this key we return to the window showing the measurements for the Link Margin, CBER, MER and BCHBER.

3.3.3.2.2.4.4.4.- MPEG

This function demodulates the DVB-S2 signal, making it possible to view the image for **open broadcast MPEG2 (standard resolution) channels**.

Operation is the same as for MPEG in COFDM (see 3.3.3.2.2.4.1.4).

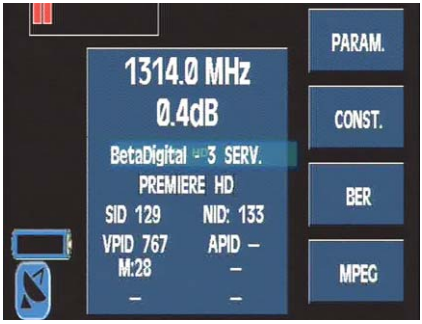


Figure 105.- MPEG

3.3.3.2.2.4.4.- DAB

When we enter DAB mode (terrestrial or satellite) the equipment automatically selectes the DAB channel plan. The operation mode is similar to other BER measurements (COFDM, QPSK, or QAM).

To access this function press:

TV mode ⇒ Measurements ⇒ Digital ⇒ DAB (Both in the terrestrial band as well as in the satellite band).

When the channel is locked on, if we press the **SERV** button, we will be able to select the service that we want to listen to from a list.

The meter features DAB channel plans, both for the terrestrial as well as for the satellite bands. When the user accesses this function, the meter automatically selects the DAB channel plan according to the selected band, whatever mode the user is in. When exiting this function, the meter will return to the original mode.

The information on the DAB screen is shown in the figure.

There are two types of information:

On the one hand, the measurements that indicate the **signal quality**: BER and SN and,

on the other hand, **the information** on the signal content: the number of services, their identifiers, and information on the current service that is being unscrambled. This information consists of the signal binary regime, the service number, the signal quality (stereo, joint stereo...).

The information given in the DAB channels is the following: S/N, BER, service identifier and the names of the services, as can be seen here:

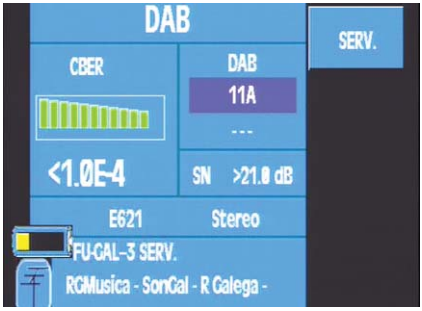


Figure 106.- Information on the DAB measurements

By default, once in sync with the channel, service **0** is demodulated from the list of services, and we will be able to change the service by pressing **SERV**. A list of the names of the services will appear where the user will be able to select the desired service.

Note: *When exiting the DAB measurement, the meter will automatically select the dBµV unit. To change the unit in use, see section 3.3.2.4.- Units.*

Figure 107.- DAB service selection

To change service, use the rotating knob. To confirm, press Enter.

Note: *In DAB the user will not be able to enter a frequency directly, move in frequency mode or change the channel plan.*

A DAB memory in a macromeasurement carries out 2 measurements: BER and SN.

3.3.3.2.2.4.5.- WLAN

The meter allows users to detect and analyse all Wireless Local Area Networks (WLAN) according to the 802.11b/g standard operating on the 2.4 GHz wavelength.

Note: The meter is supplied without the antenna connected. Before using the WLAN functions, install the omnidirectional antenna included with the device.

This feature is only available in TV mode.

This function is accessed by pressing down quickly on the WiFi shortcut key.

3.3.3.2.2.4.6.1.- Channels

Once the WLAN option is selected, the device will start to search for WLANs.

As access points are detected, they will be shown on the screen. If any access point is no longer detected, it will be shown in grey.

The total number of WLANs will be shown, as well as the following information for each access point:

Channel (CH): The channel on which the access point is operating.

Power (PW): Power received

Encrypted: A padlock icon indicates that the WLAN is password protected

SSID: Identification of the WLAN.

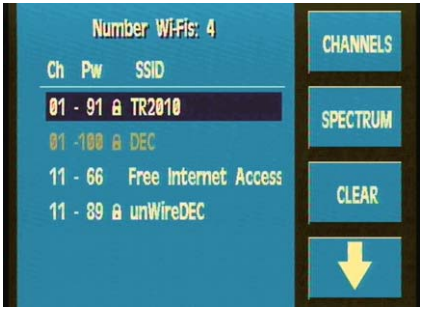


Figure 108.- WLAN

By turning the rotating knob, each of the WLAN can be selected, and by pressing the rotating knob Enter more information will be shown for the WLAN.

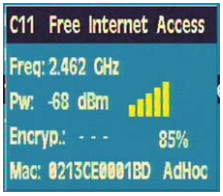


Figure 109.- Information on a WLAN

3.3.3.2.2.4.6.2.- Spectrum mode

This option allows users to visualise in which spectrum channels there is an access point.

A graph will be shown indicating in which channels there is a WLAN, as well as the power received from the access point operating on this channel. The colour of the bar indicates if the

power received is optimum (green), acceptable (yellow), or insufficient (red).

If more than one access point is operating on a channel, the highest power received from the WLAN operating on this channel will be shown, and will be indicated with a '+' sign on the power bar.

By turning the rotating knob we can move through the different channels (the current channel selected will be indicated with an arrow above the bar), and by pressing the rotating knob Enter a graph will be shown indicating the access points that operate on the selected channel.

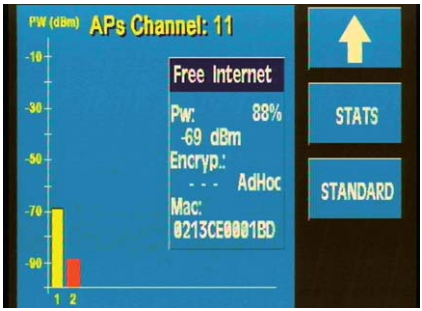


Figure 110.- Spectrum mode in WLAN

3.3.3.2.2.4.6.3.- Clear

Delete all the stored information of CHANNEL, SPECTRUM or STATISTICS mode.

3.3.3.2.2.4.6.4.- Statistics Mode

This option classifies the WLANs according to the indicator of "the percentage of times the WLAN has been detected".

The five access points that have the highest percentages will be shown. The five best access points from the whole of the spectrum or the five access points with the best channel indicator can be selected simply by moving the rotating knob.

3.3.3.2.2.4.6.5.- Standard

Allows to select the Wifi standard that the meter will use: ETSI, FCC or TELEC.

3.3.3.3.- Channel search (short cut button 3)

The **FSM 650** features an automatic channel search function. The search is carried out according to a certain threshold as defined by the user in the Search Level.

Channel search is a simplified function of SCAN&LOG. If you want the meter to search, identify and carry out automatic measuring, see paragraph 3.3.1.4.3.3.

It also depends on whether the meter is in channel tuning mode or frequency tuning mode.

If the meter is in channel tuning mode, it is carried out according to the selected channel plan. The equipment automatically searches for the corresponding channel according to the plan and if the video carrier level is higher than the search level, then the channel is tuned in. If it is not, it progresses onto the next channel, and so on until it finds a channel with a video carrier level higher than the threshold defined by the user.

If however, the meter is in frequency tuning mode, the selected channel plan is not taken into account. Instead the meter uses the frequencies in the spectrum. When the equipment finds a frequency that is higher than the established threshold, it carries out a selective search within a specific margin of frequencies to find the maximum and then it tunes that frequency as the video carrier. If, once a channel has been tuned in this way, the equipment switches to channel tuning mode, the tuned channel may not be in the selected channel plan, so the equipment will tune the nearest channel within this plan.

The automatic channel search can be a very useful function when checking an installation. Thanks to this function, it is possible to see the channels automatically and in sequence, without having saved the channels previously or even without knowing which channels are present.

This menu has the following submenus:

Figure 111.- Channel search options

Note: *When using this function, the meter will change automatically to the dBµV measurement unit. To change the unit, see section 3.3.2.4.- Units.*

3.3.3.3.1.- Search level

This parameter defines the threshold that the video carrier must surpass for the equipment to tune a specific channel when carrying out an automatic search. When this function is selected, a window opens onscreen, and the value of the search level can be modified using the rotating knob. The possible values range from 40 and 120 dBµV.

It is best to program a search value that is close to the signal level that we are using in the equipment, in other words, if we want to scan through the channels of a headend quickly using this function, if the headend output is at approximately 115 dbµV, the correct way to proceed is to program search values that are higher than 110 dbµV.

If we enter values that are very low compared to the level that we are using (for example 60 dbµV in this case), we are helping to saturate the equipment and using this function incorrectly.

Figure 112.- Search level

3.3.3.3.2.- Next

This tunes the channel that has a video carrier level that surpasses the search level and that is immediately next in frequency to the tuned channel.

3.3.3.3.3.- Previous

This tunes the channel that has a video carrier level that surpasses the search level and that is immediately before in frequency to the tuned channel.

3.3.3.4.- Nicam

This function activates the NICAM mode. This mode presents the BER NICAM measurement, and it also disposes of the audio selection. To select the audio, we must choose the desired channel using the rotating knob and press Enter (OFF, Nicam A, Nicam B).

Figure 113.- NICAM mode activated

3.3.3.5.- Selecting the Audio Carrier

The options that appear here depend on the band and on the colour standard that has been selected:

Band	Terrestrial	Satellite
PAL B/G	5.50 & 5.74	7.02 & 7.20
PAL D/K	6.50 & 6.74	
PAL I	6.00	
SECAM B/G	5.50 & 5.74	
SECAM L	6.50 6 5.85	
SECAM D/K	6.50 & 5.85	

To select the option that you want, use the rotating knob.

As well as the frequencies of the audio carrier of each standard, there are two more option in the window: **Freq.** and **Level**. If we select **Freq.**, the audio carrier selection window will close and another window will open in which the user can select another frequency from “4,00” to “9,00” using the rotating knob. The **Level** option activates the audio signal that indicates the carrier level. This is a tone which changes according to the variations in the signal level, in other words, the higher the level, the higher the tone (higher frequency).

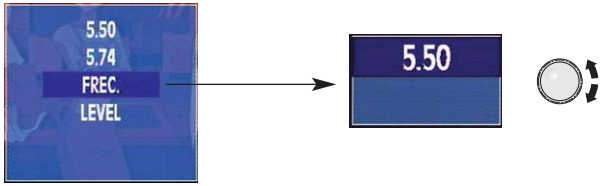


Figure 114.- Audio carrier

To close the window use the **Clear** button.

3.3.3.6.- FM radio

This function lets you tune the radio in modulated frequency. When this function is selected, a window opens onscreen where you can see the frequency and the signal level of this frequency.

You can vary the tuned frequency using the rotating knob or entering the value by pressing the **Freq.** button. The frequency values are between 88 and 108 Mhz.

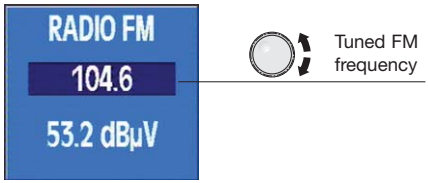


Figure 115.- Tuned radio frequency

3.3.4.- Spectrum (short cut button 5)

If this menu is chosen, the meter passes straight to the spectrum analyzer mode. In this mode you can see the signal spectrum according to the selected span and the tuned frequency. The lower part of the screen (under the spectrum) is used to display the parameters, measurements, etc. The menu texts are hidden by default, so that it is easier to see the spectrum properly.

When you need to access the menus, simply press the **Clear/Menu** button or any of the A B, C or D buttons.

If an analogue measurement is selected, the central part of the spectrum will display a dotted yellow line, and if a digital measurement is selected, this line does not appear and instead there are two dotted yellow lines at an equal distance from the spectrum's central line. The separation between these lines indicates the channel bandwidth that is selected at that moment.

It is worth noting that, with this meter, you can see any frequency between 5 and 2150 MHz **without interruptions**.

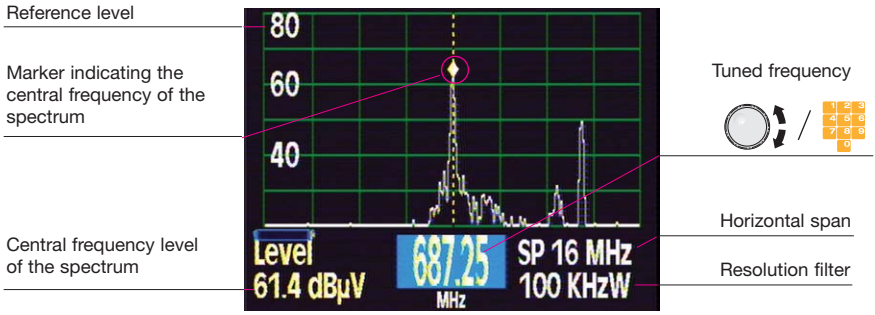


Figure 116.- Spectrum analyzer mode. Frequency tuning (analogue channel)

Figure 117.- Spectrum analyzer mode. Channel tuning (digital channel)

The information about the tuned frequency or channel appears at the bottom of the screen.

If the equipment is in frequency mode, the central frequency of the spectrum will appear. If we turn the rotating knob, we can change the central frequency, in other words, we move the spectrum to one side or the other.

If the equipment is in channel tuning mode and in analogue mode, the channel with the tuned frequency will appear and the spectrum will automatically be centred on the frequency of the video carrier of this channel. In digital mode, it is positioned in the centre of the channel. If we turn the rotating knob while in channel mode, we will pass onto the next channel and the spectrum will go to the next video carrier.

The corresponding submenu is the following:

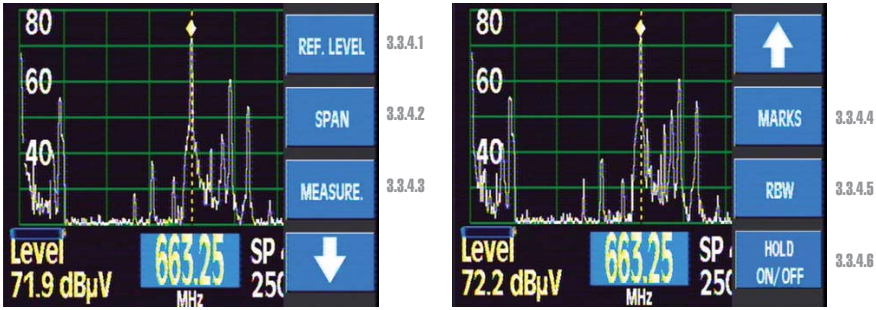


Figure 118.- Spectrum mode options

Note: *In analyser mode, it is not possible to use the dbµV/m unit.*

3.3.4.1.- Reference Level

This allows you to select the reference level of the spectrum in order to optimize the view of the spectrum of the signal according to its level. The reference level corresponds to the value of the upper horizontal line of the spectrum. The possible values are from 60 dBµV to 130 dBµV in steps of 10 for the terrestrial band, and up to 120 dBµV in the satellite band. When this function is chosen, the infomation about the level disappears for a moment and reference level options appear in its place. These are all viewed by turning the rotating knob. When it is pressed, the value is selected. Then the reference level information disappears and the signal level information re-appears. Any changes in this value can be seen on the spectrum. This makes it easier to know which reference level value is the best for the optimum viewing of the spectrum.

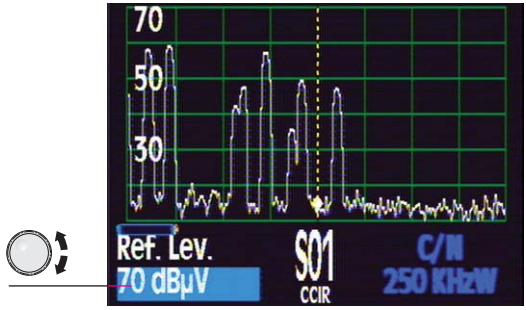


Figure 119.- Reference level

3.3.4.2.- Span

This function lets you vary the range of frequencies that is represented by the spectrum. The information for the selection of the parameter is displayed on the lower right-hand part of the screen. As is the case with the Reference Level, the information about the level disappears for a moment and the information about the span appears. The different options for this parameter appear as the rotating knob is turned. When the rotating knob is pressed, the value is selected and the menus disappear from the screen.

The possible values in the **FSM 650 meter** are:

Terrestrial band: 8, 16, 32, 48, 96, 192, 496 MHz, Full Span

Satellite band: 25, 50, 100, 200, 512 MHz, Full Span

3.3.4.3.- Measurements

The measurements are displayed at the bottom of the screen. While any measurement is being viewed, the tuned frequency can be varied by turning the rotating knob. This means that the measurement can be carried out with different frequencies or channels.

When a measurement is selected, the texts automatically disappear from the menus so that they do not stop the user from seeing the selected measurement and the signal spectrum properly.

The measurements submenu in spectrum mode is the same as the submenu in TV mode:

3.3.4.3.1.- Analogue

3.3.4.3.1.1.- Level

The measurement of the level is seen on the lower left-hand part of the screen. The frequency that is used for this measurement is the spectrum's central frequency (see the mark). If you vary the tuned frequency with the rotating knob, you will see how the level measurement also changes.

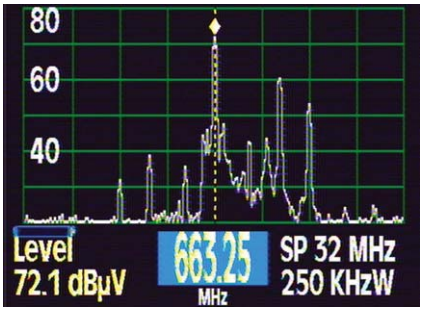


Figure 120.- Signal level

3.3.4.3.1.2.- V/A

The measurement of the audio carrier level/ video carrier level ratio is displayed on the lower right-hand part of the screen. The spectrum's central frequency is taken as the carrier frequency, and the audio carrier level is measured in the frequency that is indicated in the audio carrier selection (this function is in *TV Mode - Sel. Audio Carrier).*

On the left-hand side, you can see the measurement of the central frequency level.

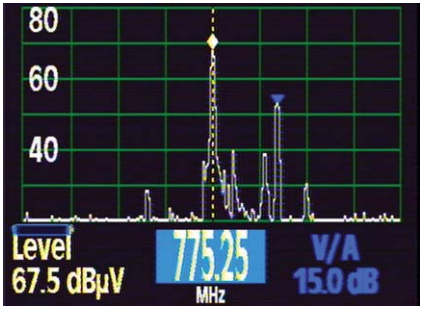


Figure 121.- A/V carrier ratio

3.3.4.3.1.3.- Automatic C/N

The C/N measurement is also displayed on the lower part of the screen.

As is the case with the V/A measurement, the carrier level is measured in the spectrum's central frequency

The equipment selects the frequency that is used to measure the noise.

3.3.4.3.1.4.- Referenced C/N

In the case of the referenced C/N, the frequency that is used to measure the noise must be selected by the user. When using this function, a second blue marker appears on the spectrum, indicating the frequency that is being used to measure the noise.

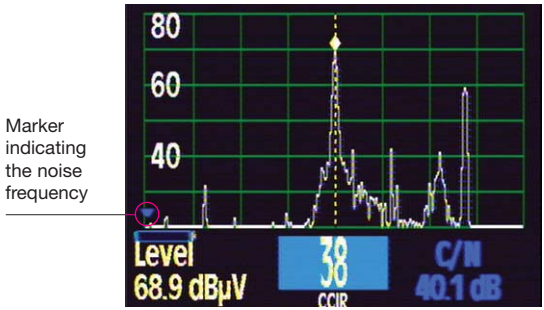


Figure 122.- Referenced C/N

To access the submenu of this function where the frequency at which the noise level is measured and the channel bandwidth are selected, you must press the **Clear/Menu** button. The menus will appear again and we can select these parameters. The options for these

parameters are displayed on the lower left-hand part of the screen; the level measurement disappears for a moment, and once the desired value has been selected (by pressing the rotating knob), the level measurement re-appears:

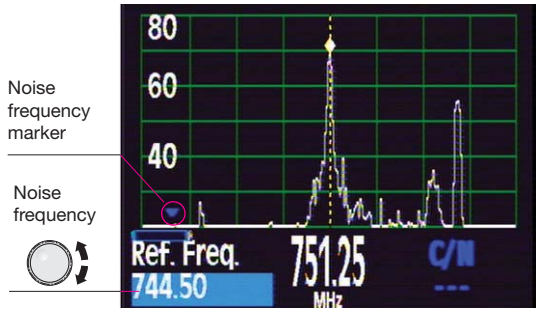


Figure 123.- Noise measurement

3.3.4.3.1.4.1.- Reference frequency

This function lets you vary the frequency that will be used to measure the noise. The rotating knob moves the blue marker so that it passes through all of the frequencies that are visible onscreen. Once the marker is over the desired frequency, press the rotating knob. This will now be used as a reference to measure the C/N.

It is important to point out that the noise frequency marker (blue) can only be moved through the frequencies that can be seen onscreen. Therefore, if the user wants to select another frequency that is not in this range, it will be necessary to select a greater horizontal span.

3.3.4.3.1.4.2.-Channel bandwidth

To take a correct measurement of the C/N, the user must select the channel bandwidth, as this is the parameter that will be used to correct the value of the noise level that is measured using the reference frequency in order to apply it to the whole channel bandwidth.

3.3.4.3.2.- Digital

3.3.4.3.2.1.- Channel power

The channel power is displayed on the lower left-hand part of the screen. For this measurement, the meter takes the spectrum's central frequency (the tuned frequency) to be the central frequency of the digital channel. This is important if the channel power is to be measured correctly. To carry out this measurement it is also very important to select the channel bandwidth.

The equipment carries out the calculation of the digital power automatically (lower left-hand part of the screen). When choosing the reference level, it is important for the digital power of the channel not to surpass this reference, as the equipment would become saturated and the results may not be correct.

If this situation is detected, the meter will show a signal indicating that the signal is saturated.

See that the digital power is clearly higher than the analogue level that the equipment indicates.

The submenu allows us to select the channel bandwidth.

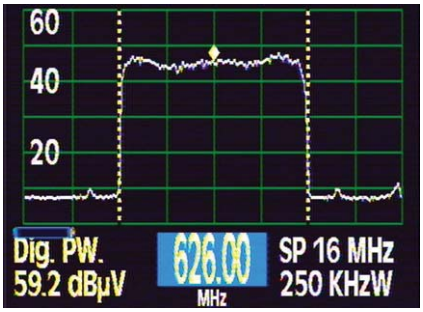


Figure 124.- Power of a digital channel

3.3.4.3.2.1.1.- Channel bandwidth

When this parameter is being selected, the information about the channel power measurement disappears and the channel bandwidth appears in its place. This can be modified using the rotating knob. To select the desired value, press the rotating knob. The bandwidth information will disappear and the power measurement information will appear again.

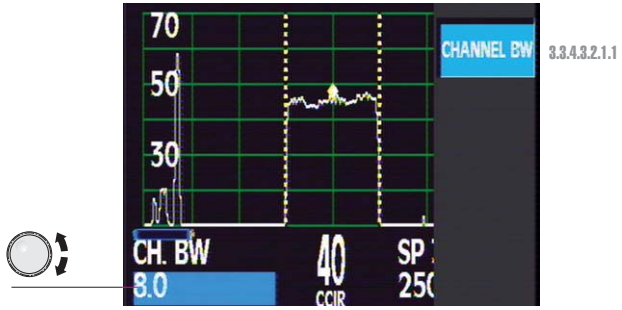


Figure 125.- Bandwidth of the digital channel

3.3.4.3.2.2.- Automatic C/N

The automatic C/N measurement for digital channels is the same as for analogue channels. This function has the following submenu:

3.3.4.3.2.2.1.- Channel bandwidth

When this parameter is selected, the information about the channel power measurement disappears and the channel bandwidth appears in its place. This can be modified using the rotating knob. To select the desired value, press the rotating knob. The bandwidth information will disappear and the power measurement information will appear again.

3.3.4.3.2.3.- Referenced C/N

The measurement of the C/N of digital channels is also displayed on the lower left-hand part of the screen. The user must select the frequency value that will be used to carry out the noise measurement and the channel bandwidth. This function has the following submenu:

3.3.4.3.2.3.1.- Reference frequency

This function lets you vary the frequency that will be used to measure the noise. Use the rotating knob to move the blue marker through the range of frequencies that are visible onscreen. Once the marker is signalling the desired frequency, press the rotating knob. The C/N measurement will be carried out using this frequency as the noise reference.

3.3.4.3.2.3.2.- Channel bandwidth

When this parameter is selected, the information about the channel power measurement disappears and the channel bandwidth appears in its place. This can be modified using the rotating knob. To select the desired value, press the rotating knob. The bandwidth information will disappear and the power measurement information will appear again.

3.3.4.4. Markers

The **FSM 650** has the possibility of using two markers on the screen. Using the functions of this submenu, you can move them through the whole spectrum to carry out the level measurements in the two marked frequencies.

The submenu is:

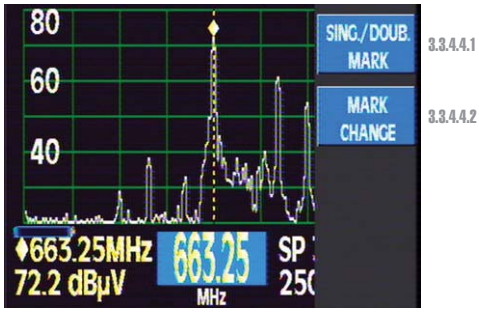


Figure 126.- Marker options

3.3.4.4.1.- Simple/Double marker

By default, when you access this submenu, there will only be one yellow marker on the spectrum. If you select this function, another marker will appear (blue).

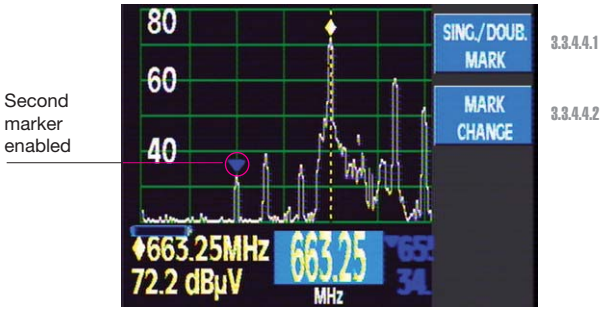


Figure 127.- Second marker

Simply press this option again to make the blue marker disappear.

3.3.4.4.2.- Changing markers

This function lets you move the markers around the spectrum, thereby varying the frequency of each one.

If you press this function, you select the blue marker:

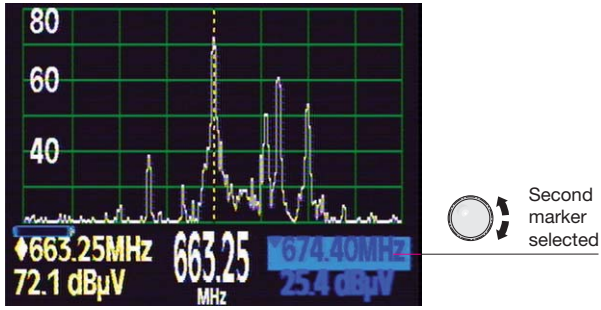


Figure 128.- Second marker enabled

When the marker is selected, you can move it along the spectrum that is visible onscreen (this will depend on the selected span) by using the rotating knob.

If this option is pressed again, the yellow marker will be selected, and you can move this in the same way

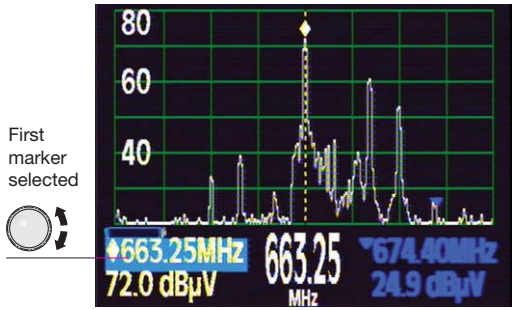


Figure 129.- First marker enabled

3.3.4.5.- RBW

The **FSM 650** uses the four I.F. filters automatically, depending on the selected SPAN. Using this function you can modify the bandwidth of the resolution filter. The possible values are: **100 KHz**, **250 KHz**, **1 MHz** and **3 MHz**

The selection you have made will be kept while the horizontal span does not change, as when this parameter changes the equipment selects the resolution filter that is appropriate for the new span. Once the new span has been selected, if you wish to use a different filter, you need to use this function again.

It is necessary to note that if an inappropriate resolution filter bandwidth is selected, the measurement carried out by the equipment may not be correct. For example, if you are using a large horizontal span and you select a narrow measurement filter, the measurement that is carried out on the signal will not be correct. Therefore, it is advisable to use the resolution filter that is automatically selected by the equipment when the horizontal span varies.

3.3.4.6.- Hold (On/Off)

This function **represents pulse signals** or signals that **change quickly**.

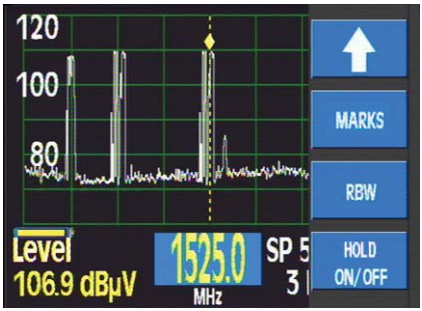
When you select it, a yellow graph will appear which indicates the maximum signal levels at each point.

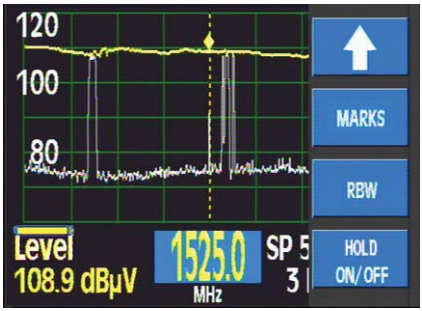
When you select it again, this graph disappears.

In both cases, the white graph will continue to represent the instantaneous signal.

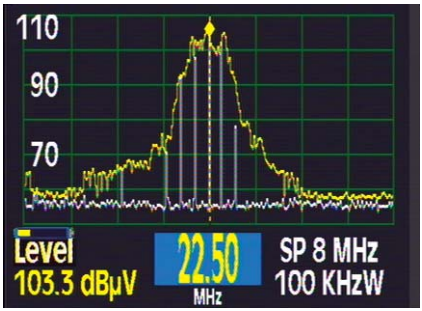
This function cannot be used to carry out a measurement of the digital power.

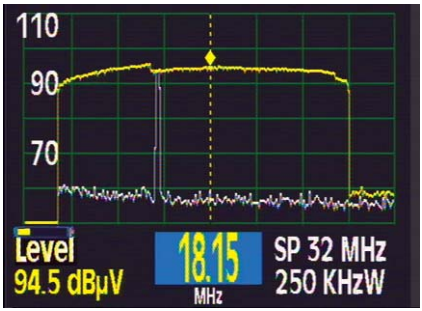
When any of the parameters of the spectrum are modified (reference level, RBW, Span) the graph that represents the maximum levels will disappear and it will begin to discover the maximum levels again taking into account the new conditions that have been selected.





(Example with an IF simulator - ref. 4008)





(Ex. Televés Integra carriers - ref. 7622) (Ex. Return Channel Generator - ref. 7637)

Figure 130.- Selection of the maximum levels (ON/OFF)

3.4.- ERROR WARNINGS

When the equipment detects an error in any of the modules or components, it warns the user through a series of messages as can be seen below:

- **NO BAT. :**

  This message appears when the equipment is switched on and no batteries are detected. The equipment operates correctly while connected to the mains.

  The same message appears when the user wishes to charge the batteries and there are no batteries connected to the equipment.

- **WRONG BATT:**

  This message appears when the equipment is switched on and when the batteries that are being used are not the same as the ones that come with the equipment from the factory or when the position of the configuration microswitches of the battery (side of the equipment) are not in the correct position. When the equipment displays this error message, it is impossible to charge the batteries (*see section 3.3.2.6.2*).

- **FULL BAT :**

  This message will appear when the user tries to charge a battery that is already charged.

- **EXCESS TEMP:**

  The equipment continuously monitors the temperature. When it is too high, this message flashes onscreen. If the temperature does not go down, the equipment shuts down automatically. If the temperature goes down, the message disappears.

  If this message appears, it is advisable to improve the conditions in temperature. The user can carry out various modifications, for example, place the equipment in a more ventilated area, take away any objects that may be blocking its ventilation, stop charging the batteries (button

) if the equipment is in use.

  If this warning message does not disappear, it is advisable to switch the equipment off while **keeping the external power supply connected**, to facilitate the elimination of the internal heat.

- **ERROR XXXX:**

  When the equipment is switched on, it checks all of its modules. When it detects an error in any of these, an **ERROR** message will appear followed by a code. If this happens, please contact your local Televés distributor, informing him/her of this error code.

- **ERR CHARGE:**

  When the DC adapter is connected to the equipment, this checks the current in the external powering connector (31). If the equipment detects an erronious current, it warns the user via an error message which flashes onscreen. The **Ext. Supply** LED will also flash.

- **Vext.:**

  This error message appears when the voltage of the external units is selected and when the equipment detects a different current in the “F” connector than that selected by the user.

· **NO POWERING:**

This message appears when the user tries to charge the batteries and there is no external powering.

· **SHORT CIRCUIT:**

This message appears when the equipment detects a shortcircuit in the “F” connector. The equipment will also emit a noise. The powering will be cut off and it will try again every 3 seconds.

· **EXCESS CURRENT:**

This message appears when the power consumption surpasses the maximum allowed. The powering is cut off and it will try again every 3 seconds.

· **No DiSEqC. Vdc off:** This message appears when one of the DiSEqC inputs is selected when the powering of external units is switched off.

4.- DESCRIPTION OF THE INPUTS AND OUTPUTS

4.1.- RF INPUT

The RF input is through the connector (30) on the side panel. The maximum signal level should never exceed 130 dBµV. This connector is easily replaced when this becomes necessary.

4.2.- RS-232C SERIAL PORT

The **FSM 650** features an RS-232C serial port for exchanging data with a PC or any other device. The signals in this connector are described below:

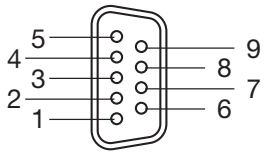


Figure 131.- RS 232 connector

PIN Nº	SIGNAL	SPECIFICATIONS
1	-	(not connected)
2	Data Request (RxD)	
3	Data Transmit (TxD)	
4	-	(not connected)
5	Ground (GND)	
6	-	(not connected)
7	-	(not connected)
8	-	(not connected)
9	-	(not connected)

4.3.- SCART (DIN EN 50049)

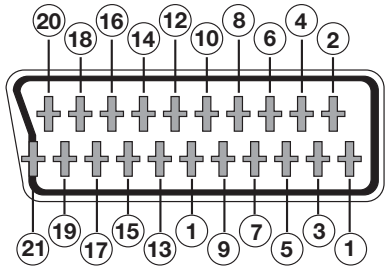


Figure 132.- SCART

Also known as a PERITEL connector (in compliance with standard NF-C92250).

The signals in this connector are as follows:

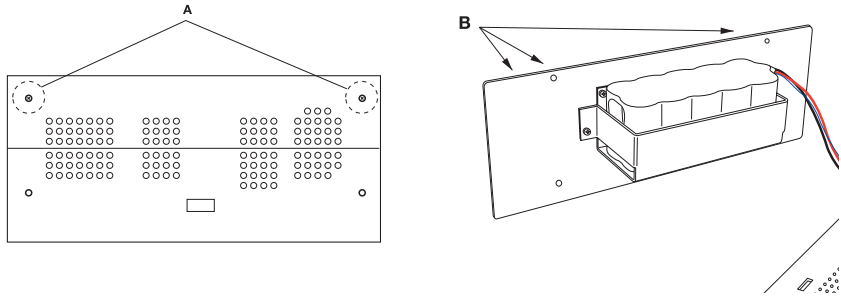
PIN Nº	SIGNAL	SPECS.	PIN Nº	SIGNAL	SPECS.
1	Right ch. audio output		12	Digital bus interface	(N/C)
2	Right ch. audio input		13	Red grounding (R)	
3	Left ch. output output		14	Digital bus reserved	(N/C)
4	Audio grounding		15	Red output (R)	
5	Blue grounding (B)		16	Blanked signal	(N/C)
6	Left ch. audio input		17	Composite video gnd	
7	Blue output (B)		18	Blanked return	(N/C)
8	Switching voltage		19	Composite video output	
9	Green grounding (G)		20	Video input	
10	Digital bus interface	(N/C)	21	Connector shield grounding	
11	Green output (G)				

5.- MAINTENANCE

5.1.- REPLACING THE BATTERY

The battery should be replaced when its capacity (fully-charged) has diminished considerably. To ensure that the equipment operates correctly, it should be provided by Televés, as it should incorporate the appropriate protective features.

To replace the battery, follow the procedure explained below:



- Switch the equipment off and disconnect the external power supply
- Remove the protective holster, if in place.
- Remove the 5 screws (A) that secure the top of the meter and take the top off.
- The battery compartment is located in the rear panel of the equipment. Remove the 4 fixing screws (B) as shown in the previous figure. Remove the rear panel.
- In order to remove the battery completely, you need to disconnect it from the connector that is located inside the meter. Follow the cables from the battery to find this connector.
- For the protective features of the batteries to work properly, place the new batteries in the same position as the old batteries.
- Connect the terminals to the new batteries. Remember to watch out for the position of the connector.
- Replace the panel and fix it securely using the 4 screws (B). Do the same with the top and the remaining screws (A). Finally replace the protective holster.
- If you also changed the battery model, update this in the microswitch (*see section 3.3.2.6.2*).
- Inform the software of the equipment of the change in batteries (*see section 3.3.2.6.2*).

WARNING

Avoid any type of shortcircuit between the cables to the battery as this could cause serious damage to the equipment.

Note: *Remember to dispose of the batteries in the appropriate places provided*

Ni-MH

5.2.- CLEANING INSTRUCTIONS

WARNING

Before cleaning the cover, make sure that the equipment is disconnected.

Do not use scented hydrocarbons or chlorinated solvents.

These products may harm the materials used for the cover.

The cover can be cleaned with a bit of normal cleaning liquid and water, using a soft damp cloth.

Dry thoroughly before using the equipment.

WARNING

Do not use alcohol or products containing alcohol to clean the front panel or the viewfinders, as these products may harm the mechanical properties of the materials used, and therefore reduce their operative life.

APPENDIX 1.- Batteríes

Below is a list of the safety measures that must be taken into account as regards the batteries:

This equipment contains a Ni-MH battery packet.

· The **charging** of the batteries should always be carried out with the batteries located inside the meter and using the **DC adapter that is provided** with the equipment. This is the only way to guarantee their long life. The use of another battery charger may harm the battery packet or cause it to explode.

· **Do not connect** the battery directly to a **high voltage** source, such as the car lighter. This high voltage would harm the battery immediately

· **Do not cause a shortcircuit** in the battery packet and **do not put** the batteries into direct contact with **a metal object**. Isolating elements should be used that are resistant to heat and acid. Battery spillage without isolating elements can cause smoke and fire

· **Do not place** the batteries near to any element which may cause **sparks** (such as a fuse or a switch). The battery can produce inflammable gases when charged. Also remember to **keep the battery away from fire**.

· The Ni-MH battery packet of this equipment may explode if exposed to fire. **Do not place** the batteries near to a **source of heat**, as they can re-heat, produce spillage, catch fire, or explode

· **Do not wet** the batteries, as this could cause it to rust, and you could run the risk of fire, or an electric shock

· Do not leave the batteries in a car when it is hot outside, or under direct sunlight, near to the heating or near fire. The use of the batteries under these conditions can cause spillage, fire or explosions

· Both **to remove** the batteries, as well as **to connect them**, make sure that the meter is **switched off**

· If you remove the battery from the equipment, when you put it back in again, **make sure that you have replaced it as it was before**

· If you are using **metal tools** for the installation of the batteries, you must **isolate it**, as they could cause a shortcircuit.

· **Do not connect** the positive terminal to the negative terminal of a battery with a metal object, the battery could re-heat, emit hydrogen gas, undergo spillage, burn or explode.

· **Do not apply a soldering iron** directly on the battery

· **Do not put** the batteries into direct contact with plastic sheeting or PVC (not rigid). Do not apply organic solvents, gasoline, kerosene or paraffin, benzene, liquid detergents or paint to the batteries. If the batteries come into contact with these substances, they can break and thus undergo spillage.

· **Do not cover** the batteries with **materials that can generate static electricity,** as this could cause fire or an explosion

· **Do not try to disassemble, re-model or destroy the batteries**. This will produce spillage, fire or explosions. Sulphuric acid could also be spilt, which could cause the skin to burn.

· The battery contains diluted sulphuric acid, a very toxic substance. If the battery undergoes any spillage and any liquid is spilt on the skin or clothes, you must wash the area immediately with lots of water, as sulphuric acid can cause the skin to burn. If the battery liquid comes into contact with the eyes, immediately wash them with lots of water and visit your doctor.

APPENDIX 2.- Channels Plan

CCIR

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
E02	48,25	E05	175,25	S16	266,25	S29	367,25	21	471,25	34	575,25	47	679,25	60	783,25
E03	55,25	E06	182,25	S17	273,25	S30	375,25	22	479,25	35	583,25	48	687,25	61	791,25
E04	62,25	E07	189,25	S18	280,25	S31	383,25	23	487,25	36	591,25	49	695,25	62	799,25
S01	105,25	E08	196,25	S19	287,25	S32	391,25	24	495,25	37	599,25	50	703,25	63	807,25
S02	112,25	E09	203,25	S20	294,25	S33	399,25	25	503,25	38	607,25	51	711,25	64	815,25
S03	119,25	E10	210,25	S21	303,25	S34	407,25	26	511,25	39	615,25	52	719,25	65	823,25
S04	126,25	E11	217,25	S22	311,25	S35	415,25	27	519,25	40	623,25	53	727,25	66	831,25
S05	133,25	E12	224,25	S23	319,25	S36	423,25	28	527,25	41	631,25	54	735,25	67	839,25
S06	140,25	S11	231,25	S24	327,25	S37	431,25	29	535,25	42	639,25	55	743,25	68	847,25
S07	147,25	S12	238,25	S25	335,25	S38	439,25	30	543,25	43	647,25	56	751,25	69	855,25
S08	154,25	S13	245,25	S26	343,25	S39	447,25	31	551,25	44	655,25	57	759,25		
S09	161,25	S14	252,25	S27	351,25	S40	455,25	32	559,25	45	663,25	58	767,25		
S10	168,25	S15	259,25	S28	359,25	S41	463,25	33	567,25	46	671,25	59	775,25		

STDL

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
A	47,75	5	208	27	519,25	35	583,25	43	647,25	51	711,25	59	775,25	67	839,25
B	55,75	6	216	28	527,25	36	591,25	44	655,25	52	719,25	60	783,25	68	847,25
C1	60,5	21	471,25	29	535,25	37	599,25	45	663,25	53	727,25	61	791,25	69	855,25
C	63,75	22	479,25	30	543,25	38	607,25	46	671,25	54	735,25	62	799,25		
1	176	23	487,25	31	551,25	39	615,25	47	679,25	55	743,25	63	807,25		
2	184	24	495,25	32	559,25	40	523,25	48	687,25	56	751,25	64	815,25		
3	192	25	503,25	33	567,25	41	631,25	49	695,25	57	759,25	65	823,25		
4	200	26	511,25	34	575,25	42	639,25	50	703,25	58	767,25	66	831,25		

OIRT

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
R1	49,75	R6	175,25	S15	279,25	S28	383,25	23	487,25	36	591,25	49	695,25	62	799,25
R2	59,25	R7	183,25	S16	287,25	S29	391,25	24	495,25	37	599,25	50	703,25	63	807,25
R3	77,25	R8	191,25	S17	295,25	S30	399,25	25	503,25	38	607,25	51	711,25	64	815,25
R4	85,25	R9	199,25	S18	303,25	S31	407,25	26	511,25	39	615,25	52	719,25	65	823,25
R5	93,25	R10	207,25	S19	311,25	S32	415,25	27	519,25	40	623,25	53	727,25	66	831,25
S1	111,25	R11	215,25	S20	319,25	S33	423,25	28	527,25	51	631,25	54	735,25	67	839,25
S2	119,25	R12	223,25	S21	327,25	S34	431,25	29	535,25	42	639,25	55	743,25	68	847,25
S3	127,25	S9	231,25	S22	335,25	S35	439,25	30	543,25	43	647,25	56	751,25	69	855,25
S4	135,25	S10	239,25	S23	343,25	S36	447,25	31	551,25	44	655,25	57	759,25		
S5	143,25	S11	247,25	S24	351,25	S37	455,25	32	559,25	45	663,25	58	767,25		
S6	151,25	S12	255,25	S25	359,25	S38	463,25	33	567,25	46	671,25	59	775,25		
S7	159,25	S13	263,25	S26	367,25	21	471,25	34	575,25	47	679,25	60	783,25		
S8	167,25	S14	271,25	S27	375,25	22	479,25	35	583,25	48	687,25	61	791,25		

CCIR-IT

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
A	53,75	H1	217,25	27	519,25	35	583,25	43	647,25	51	711,25	59	775,25	67	839,25
B	62,25	H2	224,25	28	527,25	36	591,25	44	655,25	52	719,25	60	783,25	68	847,25
C	82,25	21	471,25	29	535,25	37	599,25	45	663,25	53	727,25	61	791,25	69	855,25
D	175,25	22	479,25	30	543,25	38	607,25	46	671,25	54	735,25	62	799,25		
E	183,75	23	487,25	31	551,25	39	615,25	47	679,25	55	743,25	63	807,25		
F	192,25	24	495,25	32	559,25	40	623,25	48	687,25	56	751,25	64	815,25		
G	201,25	25	503,25	33	567,25	41	631,25	49	695,25	57	759,25	65	823,25		
H	210,25	26	511,25	34	575,25	42	639,25	50	703,25	58	767,25	66	831,25		

DAB

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
05A	174,95	06C	185.35	08A	195.95	09C	206.35	10D	215.05	12A	223.95	13B	232.50		
05B	176,65	06D	187.05	08B	197.65	09D	208.05	11A	216.95	12N	224.10	13C	234.20		
05C	178.35	07A	188.90	08C	199.35	10A	209.95	11N	217.10	12B	225.65	13D	235.75		
05D	180.05	07B	190.65	08D	201.05	10N	210.10	11B	218.65	12C	227.35	13E	237.50		
06A	181.95	07C	192.30	09A	202.95	10B	211.65	11C	220.35	12D	229.05	13F	239.20		
06B	183.65	07D	194.05	09B	204.65	10C	213.35	11D	222.05	13A	230.80				

SIMULATOR 7637

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
0	7.50	2	22.60	4	7.50	6	22.60		
1	14.75	3	18	5	14.75	7	18		

SIMULATOR 4009

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
A	85	B	750						

Televés

The frequencies in this channel plan require the use of a universal LNB

AMAZONAS 61.0º W

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
11A	1518	16C	1192	19C	992	29	1305	31	1385	14	1056	7	1222	5B	1382		
5A	1225	16D	1185	19D	982	24A	1329	25B	1386	16H	1058	8	1262	11B	1382		
6A	1209	16E	1155	19E	976	30	1345	32	1425	17	1090	9	1302	6B	1422		
16A	1204	19A	1022	19F	972	24B	1358	16F	1032	18	1150	4	1342	12	1422		
16B	1200	19B	1013	28	1265	25A	1378	16G	1042	20	1152	10	1342				

HISPASAT 1C/1D 30.0º W

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
85A	1716	86C	1784	84C	1904	77B	1187	80D	1330	55E	1455	64A	1556	65B	1947	68F	2086
85B	1720	81B	1785	84D	1911	77C	1207	46	1331	55F	1464	64B	1559	70	1950	69A	2101
85C	1724	86D	1790	84E	1917	43	1211	52	1331	55G	1470	64C	1562	65C	1964	69B	2108
85D	1729	86E	1796	84F	1923	49	1211	80E	1333	55H	1477	64D	1569	71A	1980	69C	2116
85E	1736	86F	1801	88C	1926	44	1251	57	1372	97A	1485	62	1572	71B	1986	69D	2121
85F	1742	82	1827	84G	1932	50	1251	54	1400	60	1492	64E	1575	71C	1994	69E	2126
85G	1748	87	1865	41	1131	79	1284	58	1412	97B	1493	64F	1582	71D	2003	69F	2132
85H	1753	83	1867	47	1131	45	1291	55A	1437	56A	1494	90	1626	68A	2056		
81A	1759	84A	1893	42	1171	51	1291	55B	1441	56B	1500	91	1703	68B	2062		
85I	1760	88A	1894	48	1171	80A	1307	55C	1446	61	1532	92	1780	68C	2068		
86A	1771	84B	1898	76	1175	80B	1315	55D	1450	89	1549	93	1856	68D	2074		
86B	1776	88B	1898	77A	1180	80C	1320	59	1452	63	1549	65A	1922	68E	2080		

NILESAT 101/102 & ATLANTIC BIRD 4 7.0º W

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
112	1008	120	1161	4	1185	8	1262	12	1338	16	1415	22	1530	30	1684	85	1799
114	1046	121	1180	5	1204	9	1281	13	1358	17	1434	23	1549	31	1703		
118	1123	2	1147	6	1223	10	1300	14	1377	18	1454	26	1607	82	1741		
119	1142	3	1166	7	1243	11	1319	15	1396	19	1473	27	1626	83	1760		

THOR 2/3 1.0º W

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
61A	1237	63E	1440	8	1575	65B	1720	65J	1785	69E	1912	27	1626	310XL	1920	312XL	2087
61B	1256	1A	1466	10	1607	65C	1731	65K	1794	69F	1920	28	1645	310L	1927	312U	2123
72	1343	2	1479	11	1622	65D	1740	65L	1803	69G	1925	31	1703	310U	1963	312XU	2135
62	1344	3	1497	12	1639	65E	1747	79	1856	1B	1127	32	1722	311L	2007		
63A	1416	4	1511	13	1653	65F	1752	69A	1869	6B	1223	35	1780	311XL	2007		
63B	1422	5	1528	14	1671	65G	1758	69B	1880	18	1454	36	1799	311U	2043		
63C	1429	6A	1543	15	1684	65H	1767	69C	1884	23	1549	39	1856	311XU	2043		
63D	1434	7	1559	65A	1713	65I	1775	69D	1905	24	1569	40	1876	312L	2087		

ASTRA 1C & SIRIUS 2/3 4.8º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
64	1186	5A	1204	11A	1319	17	1434	27	1626	35	1780	3E	2017	10D	2059	5C	2097
47	1421	6	1223	12A	1338	18	1454	28	1645	37	1818	4B	2032	11B	2071	11F	2101
1	1127	7	1243	13	1358	19	1473	29	1665	39	1856	10B	2037	5B	2078	12B	2135
2	1147	8	1262	14	1377	20	1492	31	1703	3B	1990	4C	2041	11C	2080		
3A	1166	9	1281	15	1396	21	1511	32	1722	3C	2000	4D	2049	11D	2090		
4A	1185	10A	1300	16	1415	23	1549	33	1741	3D	2008	10C	2050	11E	2094		

HOT BIRD 2/6/7A/8 13.0º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
110	969	121	1180	133	1429	11	1661	157	1892	59	1300	71	1528	82	1741	94	1997
111	973	122	1199	134	1450	12	1682	158	1912	60	1319	71	1545	83	1760	95	2016
112	1008	123	1221	1	1469	13	1699	159	1931	61	1338	72	1549	84	1780	96	2035
113	1025	124	1242	2	1490	14	1720	50	1127	62	1358	73	1569	85	1799	97	2054
114	1046	125	1263	3	1508	15	1738	51	1147	63	1377	74	1588	86	1818	98	2073
115	1063	126	1284	4	1528	16	1756	52	1166	64	1396	75	1607	87	1837	99	2092
115U	1080	127	1304	5	1546	17	1776	53	1185	65	1415	76	1626	88	1860	100	2113
116	1084	128	1325	6	1570	18	1791	54	1204	66	1434	77	1645	89	1876	101	2131
117	1103	129	1346	7	1584	153	1816	55	1223	67	1454	78	1665	90	1920		
118	1123	130	1367	8	1605	154	1835	56	1243	68	1473	79	1684	91	1939		
119	1142	131	1387	9	1623	155	1854	57	1262	69	1492	80	1703	92	1958		
120	1161	132	1408	10	1643	156	1873	58	1281	70	1511	81	1722	93	1977		

EUTELSAT W2 16.0º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
B1A	1207	B1J	1275	B3I	1358	B5G	1427	D1	1721	68	1932	F1H	1962	F4F	2049	F6D	2103
B1B	1212	B3A	1296	B5A	1376	B6E	1428	D2	1742	F1A	1909	F2D	1963	F3D	2050	F5F	2111
B1C	1218	B4A	1303	B6A	1382	B5H	1434	D3	1763	F1B	1917	F1I	1968	F4G	2056	F6E	2113
B2A	1222	B3B	1306	B5B	1384	B5I	1442	D4	1784	F1C	1924	F4A	2009	F5A	2076	F5G	2119
B1D	1226	B3C	1311	B5C	1392	C4A	1517	D5	1804	F1D	1932	F3A	2016	F6A	2077	F6F	2123
B1E	1239	B3D	1317	B6B	1394	C4B	1526	D6	1825	F2A	1938	F4B	2020	F5B	2083	F5H	2126
B1F	1247	B3E	1328	B5D	1400	C4C	1544	D7	1844	F1E	1939	F4C	2026	F6B	2086	F6G	2131
B1G	1255	B3F	1340	B6C	1402	C5	1554	D8	1867	F1F	1947	F3B	2030	F5C	2087	F6H	2140
B2B	1261	B4B	1342	B5E	1408	C6	1574	D9A	1884	F2B	1949	F4D	2033	F5D	2094		
B1H	1265	B3G	1344	B6D	1410	C11	1678	D10	1908	F1G	1955	F3C	2036	F6C	2095		
B1I	1271	B3H	1352	B5F	1418	C12	1699	D9B	1909	F2C	1957	F4E	2042	F5E	2103		

EUTELSAT W3A 7.0°E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
A3	1012	B1C	1227	B1I	1273	B3D	1329	B6A	1377	B5G	1421	C7	1595	D6	1825	H4	2045
A10A	1130	B1D	1231	B4A	1293	B4F	1334	B6B	1383	B6F	1425	C8	1601	D7	1846	H6	2128
A10B	1149	B2D	1236	B3A	1302	B3E	1338	B5B	1384	B5H	1430	C10A	1644	D8	1867		
A11	1178	B1E	1237	B4B	1302	B4G	1340	B6C	1392	B5I	1436	C10B	1655	D9	1887		
B1A	1209	B1F	1246	B3B	1311	B3F	1346	B5C	1395	G3	1440	C12	1702	D11	1928		
B2A	1209	B2E	1246	B4C	1311	B4H	1347	B6D	1397	B5J	1442	D1	1721	H1	1920		
B1B	1218	B1G	1255	G2A	1313	G2B	1355	B5D	1401	C3	1512	D2	1742	F2	1921		
B2B	1218	B2F	1255	B3C	1320	B3G	1356	B6E	1402	C4	1533	D3	1763	F1A	1951		
B2C	1225	B1H	1264	B4D	1320	B4I	13560	B5E	1405	C5	1549	D4	1784	H2	1962		
G1	1226	B2G	1264	B4E	1328	B5A	1376	B5F	1412	C6	1574	D5	1804	F1B	1966		

ASTRA 1E/1F/1G/1H/1KR/2C 19.2º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
49	964	63	1171	45	1391	11	1612	25	1832	71	1236	85	1510	99	1782	113	2033
50	979	64	1186	46	1406	12	1627	26	1847	72	1256	86	1529	100	1802	114	2040
51	994	33	1214	47	1421	13	1641	27	1862	73	1276	87	1548	101	1822	115	2063
52	1008	34	1229	48	1436	14	1656	28	1877	74	1295	88	1568	102	1841	116	2070
53	1023	35	1244	1	1464	15	1671	29	1891	75	1314	89	1588	103	1860	117	2092
54	1038	36	1259	2	1479	16	1686	30	1906	76	1334	90	1607	104	1880	118	2099
55	1053	37	1273	3	1494	17	1714	31	1921	77	1354	91	1626	105	1915	119	2122
56	1068	38	1288	4	1509	18	1729	32	1936	78	1373	92	1646	106	1922	120	2128
57	1082	39	1303	5	1523	19	1744	65	1120	79	1392	93	1666	107	1945		
58	1097	40	1318	6	1538	20	1759	66	1139	80	1412	94	1685	108	1952		
59	1112	41	1332	7	1553	21	1773	67	1158	81	1432	95	1704	109	1974		
60	1126	42	1347	8	1568	22	1788	68	1178	82	1451	96	1724	110	1981		
61	1141	43	1362	9	1582	23	1803	69	1198	83	1470	97	1744	111	2004		
62	1156	44	1377	10	1597	24	1818	70	1217	84	1490	98	1763	112	2010		

BADR 3/4 26.0°E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
1A	1127	5	1204	11A	1319	16	1415	21	1511	27	1626	11B	2110	11E	2128		
2	1147	6	1223	12A	1338	17	1434	22	1530	1B	1923	11C	2118	11F	2132		
3A	1166	7	1243	13	1358	18	1454	24	1569	3B	1963	11D	2124	12C	2138		
4	1185	8	1262	15	1396	19	1473	26	1607	9	2088	12B	2125	11G	2139		

ASTRA 2A/2B/2D 28.2º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
41	964	48	1068	55	1171	6	1217	13	1354	20	1490	27	1626	34	1763		
42	979	49	1082	56	1186	7	1236	14	1373	21	1510	28	1646	35	1782		
43	994	50	1097	1	1120	8	1256	15	1392	22	1529	29	1666	36	1802		
44	1008	51	1112	2	1139	9	1276	16	1412	23	1548	30	1685	37	1822		
45	1023	52	1126	3	1158	10	1295	17	1432	24	1568	31	1704	38	1841		
46	1038	53	1141	4	1178	11	1314	18	1451	25	1588	32	1724	39	1860		
47	1053	54	1156	5	1198	12	1334	19	1470	26	1607	33	1744	40	1880		

EUROBIRD 1 28.5º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
C1A	1472	C4A	1557	C6B	1676	D4S	1777	D9S	1873	F2L	1923	F4B	2011	F6D	2103		
C2A	1474	C4B	1593	C5B	1678	D5S	1796	D10S	1892	F1U	1960	F4C	2020	F6E	2112		
C2B	1510	C3B	1594	D1S	1719	D6S	1815	D11S	1912	F2U	1960	F6A	2077	F6F	2121		
C1B	1511	C5A	1639	D2S	1738	D7S	1835	D12S	1931	F4A	1993	F6B	2086				
C3A	1557	C6A	1640	D3S	1758	D8S	1854	F1L	1923	F3	2007	F6C	2095				

EUROBIRD 9 9º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
50	1127	52	1166	54	1204	56	1243	62	1358	65	1415						
51	1147	53	1185	55	1223	59	1297	63	1377	66	1434						

TURKSAT 1C/2A 42.0º E

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
4A	1205	7A	1331	1B	1742	1F	1129	3M	1179	9F	1292	16C	1408	28A	1990	30H	2064
4B	1212	7B	1339	1C	1748	2D	1134	4G	1182	10D	1292	16D	1415	28B	1995	31A	2080
4C	1218	7C	1346	10A	1800	2E	1139	4H	1188	10E	1305	16E	1422	28C	1999	31B	2088
12	1220	7D	1355	10B	1804	1G	1143	4I	1194	10F	1312	16F	1428	28D	2005	31C	2092
4D	1225	8A	1379	2A	1851	2F	1143	4J	1200	10G	1316	21A	1526	28E	2009	31D	2099
4E	1234	8B	1389	2B	1857	3F	1148	5F	1204	11B	1319	21B	1533	28F	2014	31E	2102
5A	1248	15A	1392	10C	1857	2G	1148	7E	1230	13A	1343	21C	1540	28G	2018	31F	2106
5B	1256	8C	1396	2C	1862	2H	1153	7F	1239	13B	1351	22	1540	30A	2033	34A	2115
5C	1262	15B	1396	3A	1914	3G	1154	7G	1246	13C	1359	23A	1907	29A	2034	34B	2119
5D	1269	8D	1404	3B	1919	3H	1158	7H	1252	13D	1363	23B	1913	30B	2038	34C	2122
5E	1275	8E	1409	3C	1923	2I	1160	7I	1258	14A	1366	23C	1918	30C	2041	34D	2127
6A	1287	8F	1412	3D	1932	3I	1162	9A	1267	13E	1373	23D	1924	30D	2046	34E	2131
6B	1292	16A	1425	3E	1941	3J	1165	9B	1274	14B	1384	23E	1930	29B	2052	34F	2137
6C	1298	8G	1438	11A	1944	3K	1170	9C	1278	14C	1390	23F	1936	30E	2052	34G	2142
6D	1314	8H	1445	1D	1112	3L	1173	9D	1282	15C	1396	23G	1940	30F	2057	34H	2147
6E	1319	1A	1715	1E	1116	4F	1175	9E	1287	16B	1402	26	1965	30G	2061		

I.F. SIMULATOR 4008(1)

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
0123A	960	67A_VL	960	67A_HL	990	67A_VH	960	67A_HH	990
0123B	1550	67B_VL	1550	67B_HL	1540	67B_VH	1550	67B_HH	1540
0123C	2140	67C_VL	2140	67C_HL	2110	67C_VH	2140	67C_HH	2110

HL ⟹ Horizontal pol. / Low band

VL ⟹ Vertical pol. / Low band

HH ⟹ Horizontal pol. / High band

VH ⟹ Vertical pol. / High band

(1) Values for the IF simulator 4008

0123 ⟹ Any of the four positions 0, 1, 2 or 3

67 ⟹ Any of the two positions 6 or 7

ABC ⟹ Values of the three generated frequencies

SIMULATOR 4009

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
C	1000	C_VH	1000	C_VL	1000	B_VH	2150	B_VL	2150
D	2150	C_HH	1000	C_HL	1000	B_HH	2150	B_HL	2150

DAB

CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz	CH	MHz
L1	1452.8	L7	1463.2	L13	1473.7	L19	1484.2	LA	1452.9	LG	1463.2	LM	1473.5	LS	1485.4
L2	1454.5	L8	1465	L14	1475.4	L20	1485.9	LB	1454.6	LH	1464.9	LN	1476.9	LT	1487.2
L3	1456.3	L9	1466.7	L15	1477.2	L21	1487.9	LC	1456.3	LI	1466.6	LO	1478.6	LU	1488.9
L4	1458	L10	1468.5	L16	1478.9	L22	1489.4	LD	1458	LJ	1468.3	LP	1480.3	LV	1490.6
L5	1459.7	L11	1470.2	L17	1480.7	L23	1491.1	LE	1459.8	LK	1470	LQ	1482		
L6	1461.5	L12	1472	L18	1482.4			LF	1461.5	LL	1471.7	LR	1483.7		

APPENDIX 3.- Maximum and minimum values for signal quality.

PARAMETER	UNIT	MIN VALUE	MAX VALUE
Level			
Terrestrial	dBµV	57	80
Satellite	dBµV	47	77
PW QAM	dBµV	45	70
PW COFDM	dBµV	45	70
PW QPSK	dBµV	47	77
FM	dBµV	40	70
DAB	dBµV	30	70
C/N			
Terrestrial	dB	43	---
Satellite	dB	15	---
FM	dB	38	---
COFDM	dB	25	---
QPSK	dB	11	---
DAB	dB	18	---
64QAM	dB	25	---
V/A			
Terrestrial	dB	8	20
BER			
COFDM	---	5.0E-4	
QPSK	---	5.0E-4	
QAM	---	5.0E-4	
DAB	---	1.0E-3	
NICAM	---	1.0E-3	
MER			
COFDM	dB	23	---
QPSK	dB	9	---
QAM	dB	25	---
DVB-S2	dB	3	20
S/N			
DAB	dB	12	---

TECHNICAL ASSISTANCE

At the end of the manual, there is a complete list of our closest Technical Assistance points, their telephone numbers and emails which can be used for any request or question.

REPAIR SERVICE

1º- In order to facilitate the identification of the failure, use the following table:

Code	Description
100	Battery life less than 50 % of that stipulated, after a complete charging process
200	Screen has little brightness or is switched off
300	The meter does not switch on
400	It does not work in TV mode and the SCART configuration is correct
500	Other problems. Please indicate

2º- Contact Televés through the Technical Assistance Service (consult last page of manual).

3º- If it is the advice of our Technical Assistance Service to send the meter for revision, Televés will organise the collection and delivery of the meter from and to the address that the Client indicates free of charge.

4º- You simply have to pack and identify the bulk. We recommend that you return the product in its original packaging for two reasons:

a) Only in this case are we responsible for any damage that the meter may undergo during the transportation to Televés SAT.

b) If the box already disposes of a label, pack the equipment so that this can be seen and read, if this is not possible, cut the label off and stick it back onto the packaging.

5º- If the packaging is not sufficiently good and as a result, any damage is caused, the sum will be invoiced having received the Client's approval, or the product will be returned to the client, with Televés covering the return costs.

Label to identify bulk for delivery to the Technical Assistance points.

A (receptor / receiver)

Nombre de la compañía / Company name

TELEVES SAT MEDIDORES

Dirección de entrega / Delivery address

C/ Volta do Castro S/N
Santiago de Compostela
A CORUÑA

Código postal / Postal code	Pais / Country
15706	**ESPAÑA**
Persona de contacto / Contact person	Telef.
Gestión Calidad	**981 52 22 00**

Indique motivo / Indicate reason / Motif du retour

☐	Duración batería Battery life Durée batterie
☐	Pantalla con poco brillo o apagada Screen with little brightness or switched off Ecran avec point blanc ou clignotant
☐	No enciende el medidor The meter does not switch on Pas d'allumage de l'appareil
☐	No funciona en modo TV y la configuración del SCART es correcta It does not work in TV mode and the SCART configuration is correct Ne fonctione pas en mode TV et la configuration de la peritel est correcte
☐	Otros. Indicar cual: Other problems. Please indicate: Autres. Indiquez lequel:

GUARANTEE

Televés S.A. offers a one year guarantee, beginning from the date of purchase for countries in the EEC.

For the batteries and due to the characteristics of this article, the guarantee period is limited to six months.

For countries that are not part of the EEC, the legal guarantee that is in force at the time of purchase is applied.

Keep the purchase invoice to determine this date.

During the guarantee period, **Televés S.A.** becomes position of the failures produced by defect of the material or manufacture.

The harm produced by improper usage, wear and tear, manipulation by a third party, catastrophes or any other cause beyond the control of **Televés S.A.** is not included in the guarantee.

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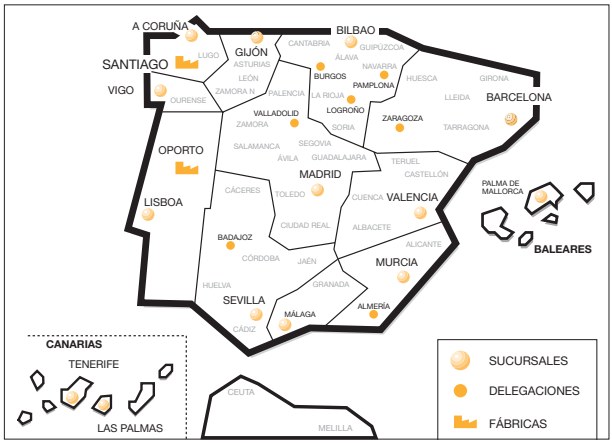

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Field Strength Meter

Multimetter FSM 650

User Manual

Ref.5923

Televés

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